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Monterey, California

INTEGRATION OF THE PRIMARY RECEIVER INTO THE NAVPGSCOL SATCOM SIGNAL ANALYZER

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Project Report

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Integration of the Primary Receiver into the Naval Postgraduate School SATCOM Signal Analyzer is presented. Circuit modifications and additions to the Primary Receiver, wiring information and operating procedures for the Primary Receiver Control Panel, and software development for system operation are presented in detail.

ABSTRACT

Integration of the Primary Receiver into the Naval Postgraduate School SATCOM Signal Analyzer is presented. Circuit modifications and additions to the Primary Receiver, wiring information and operating procedures for the Primary Receiver Control Panel, and software development for system operation are presented in detail.

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I. INTRODUCTION

A. BACKGROUND

This project is part of a series of Radio Frequency Interference (RFI) measurement and analysis projects undertaken by the NAVPGSCOL Satellite Communications Laboratory concerning UHF satellite communications. Previous efforts include evaluation of the AS 3018/WSC-1(V) shipboard antenna {Ref. 1}, preparation of a shipboard RFI measurement package {Refs. 2-5}, evaluation of shipboard RFI {Ref. 6}, construction of a shipboard RFI simulator {Ref. 7} and measurement of shipboard SATCOM terminal performance in the presence of specific RFI sources {Refs. 8-10}.

In March of 1977, this laboratory received funding from PME 106-1 of NAVELEX to develop, design, and construct a SATCOM Signal Analyzer at NAVPGSCOL. The purpose of this unit is to provide high-speed spectrum analysis and characterization of the outputs of UHF satellite transponders while operating in orbit. Previous efforts toward achieving this purpose include design of a computer system to provide control and signal analysis {Ref. 11} and design and construction of SATCOM Analyzer Receivers {Refs. 12-13}. This report will present the integration of the Primary Receiver into the SATCOM Signal Analyzer System.

B. SPECIFIC GOALS

The specific goals in the development of this system are to (1) provide all necessary equipment to make real-time measurements at the Naval Postgraduate School and (2) to provide the necessary research and development of signal analysis techniques and equipment for possible use in a follow-on version of the Fleet Satellite Monitoring System (FSM) presently in use at Naval Communications Stations to monitor GAPFILLER and FLTSAT operations.

C. SCOPE OF THIS PROJECT

This project consists basically of three parts. First, modification to existing circuits and addition of new circuits as necessary in order to achieve satisfactory operation of the Primary Receiver. Second, complete implementation of the Primary Receiver Control Panel and establish fundamental operating procedures for the control panel. Third, create software as necessary in order to allow remote operation of the Primary Receiver from its control panel. An additional part of step three is for the system to provide a means to use the AN/WSC-3 Receiver at frequencies other than those discrete values for which it was designed.

D. APPROACH

The SATCOM Signal Analyzer is constructed around an INTERDATA 7/32 minicomputer which provides system control. Other primary units directly related to this report are the

Primary Receiver and the Receiver Control Panel as shown in Figure 1. The problem of integrating these units was approached in three steps as previously outlined. These three steps are covered in detail in subsequent section of this report.

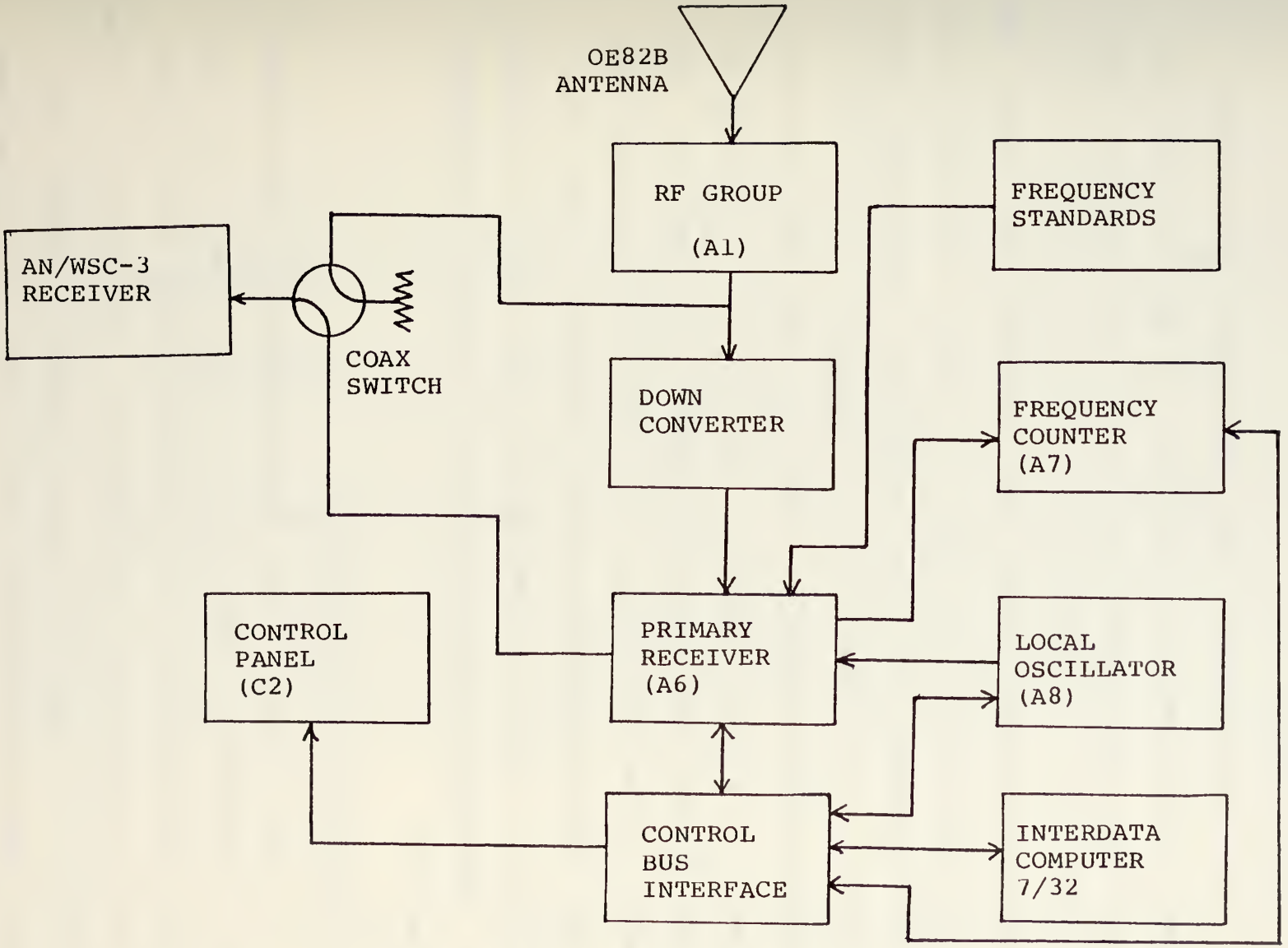


Figure 1 - Primary Receiver System Block Diagram

II. PRIMARY RECEIVER

A. GENERAL REVIEW

The Primary Receiver is a phase-locked loop receiver capable of extremely accurate carrier tracking of the output of UHF communications satellites. Switching within the receiver allows selection of one of five possible IF filter bandwidths and one of three possible phase-locked loops. Each of the phase-locked loops also is capable of operating in one of four possible loop filter bandwidths. The receiver can be operated in either the Normal or Squaring Loop mode. All of these switchable functions (IFBW, VCO, LFBW, N/SQ) can be selected at the front panel of the receiver or from the Receiver Control Panel via the INTERDATA 7/32 computer. The overall system block diagram and the Primary Receiver functional block diagrams are shown in Figures 1, 2 and 3 respectively. Figure 4 shows a front panel view of the receiver. The receiver design is covered in detail in References 12 and 13.

B. ADDITIONS AND MODIFICATIONS

In order to provide for remote operation of the receiver and to complete its operational tests in a manner such that design specifications were satisfied, certain circuit additions or modifications were necessary. New circuits or those requiring major modifications are covered in detail below. Minor circuit modifications are tabulated and/or discussed briefly as necessary.

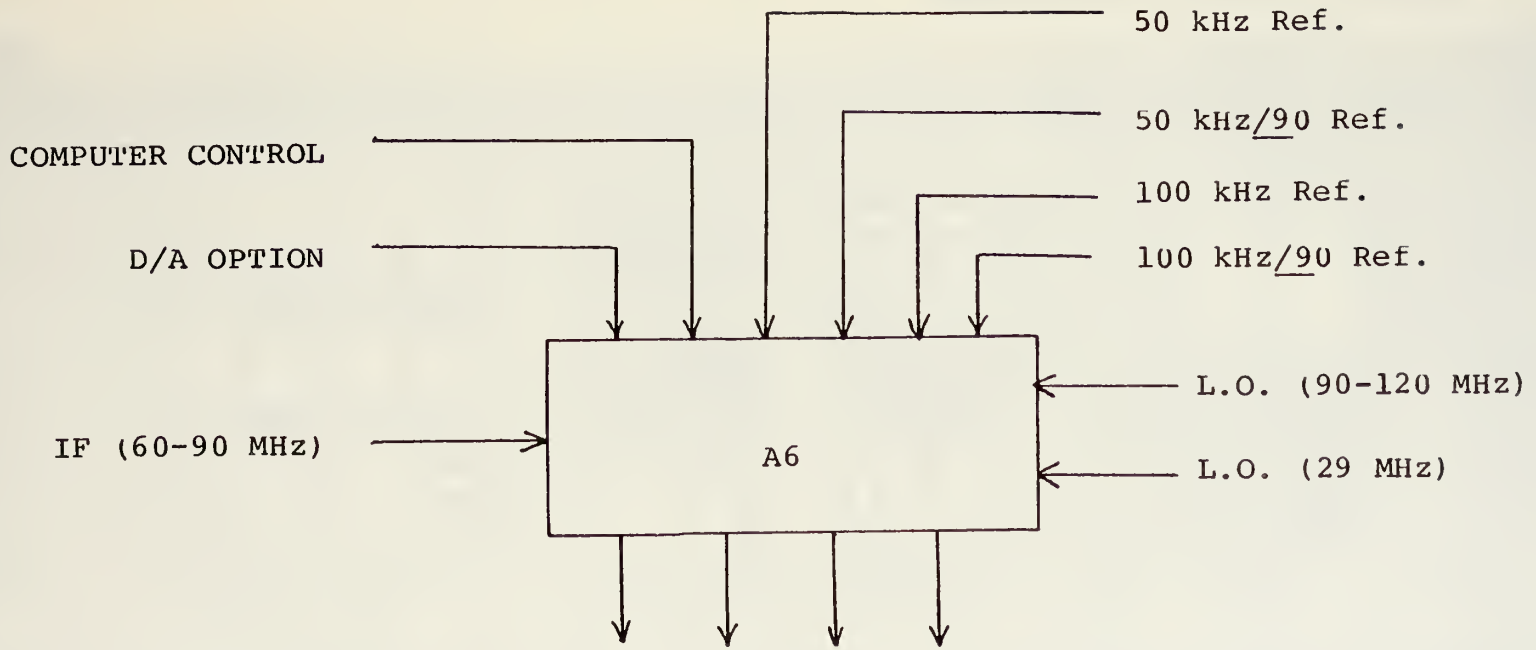


Figure 2 - Primary Receiver, System Interconnections

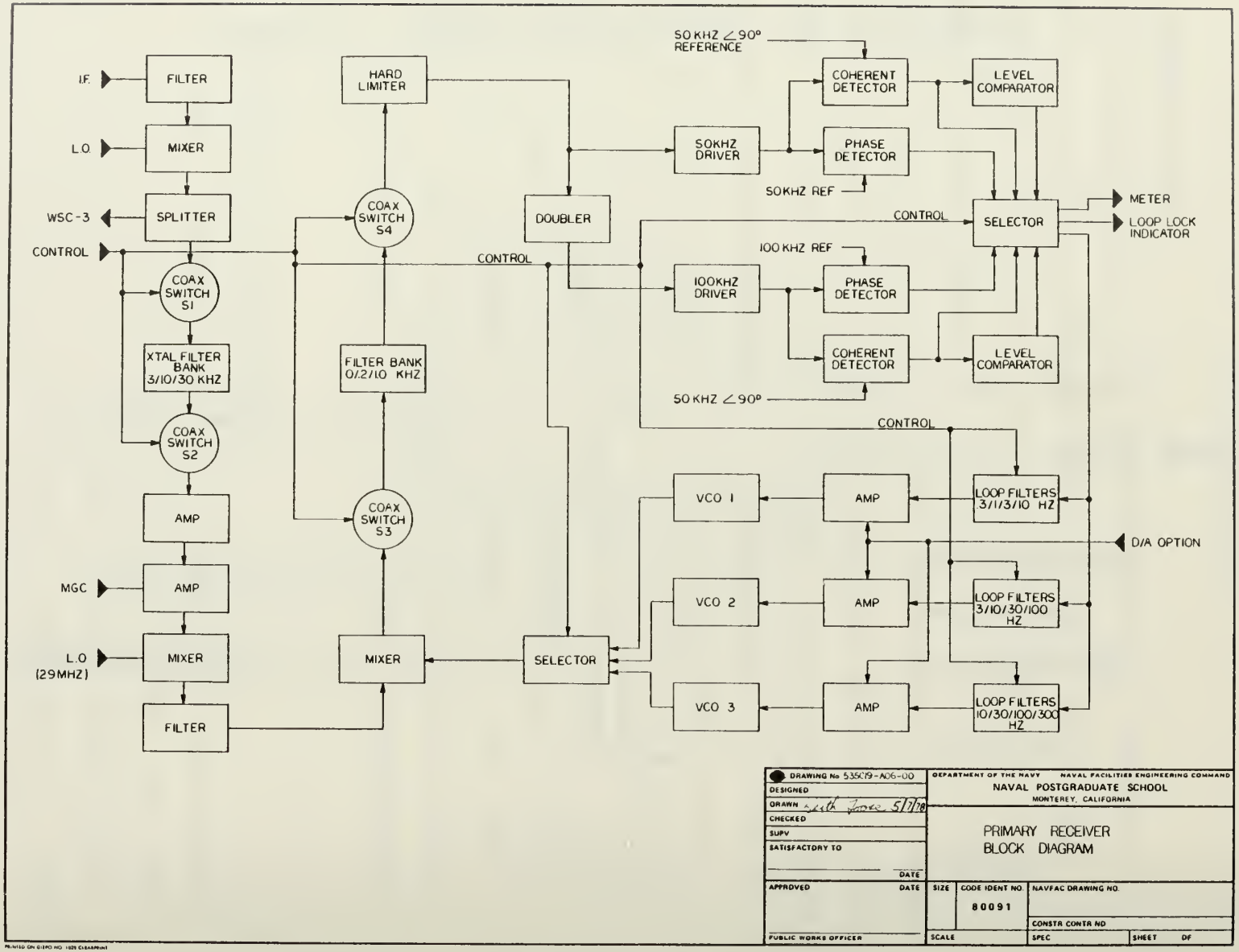


Figure 3 - Primary Receiver Block Diagram

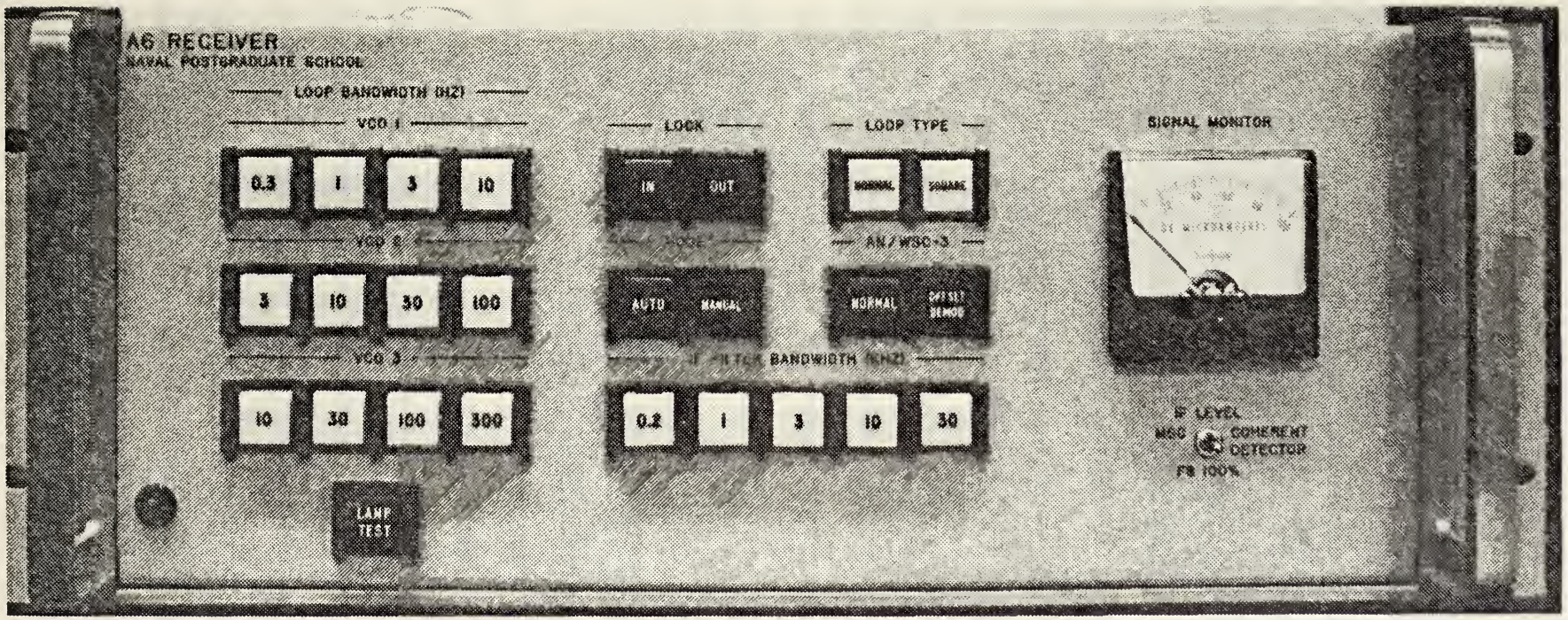


Figure 4 - Primary Receiver Front Panel Layout

1. Receiver Control Circuits

The control circuits to provide the previously discussed switching functions and automatic operation were developed using SSI and MSI logic circuits. These circuits are implemented on two universal PC boards designated PLL11 and PLL12. The functions being controlled are VCO and Loop Filter Bandwidth, IF Bandwidth, Normal or Squaring Loop, Local or Remote Operation, Reset of VCO. The control boards also provide IN/OUT of lock status information, and control of the front panel indicator lights. The inputs to the control boards come from either the front panel (local operation) or from Control Panel C2 (remote operation). Schematic diagrams and component layouts for the control boards are shown in Figures 5 through 8. Tables I and II list the wiring connections for the boards.

2. Manual Gain Control Circuit

The MGC circuit is constructed on a piece of universal printed circuit board and mounted in the left rear corner of the receiver. The MGC potentiometer is mounted next to the board. The MGC manually sets the operating level of the IF Amp and provides a front panel meter indication of that level as a percentage of the amplifier's capability. The schematic and component layout for the MGC are shown in Figures 9 and 10. The indicator (L1) and 8 ohm resistors are discussed in other section (II-B-3 and 4) of this report.

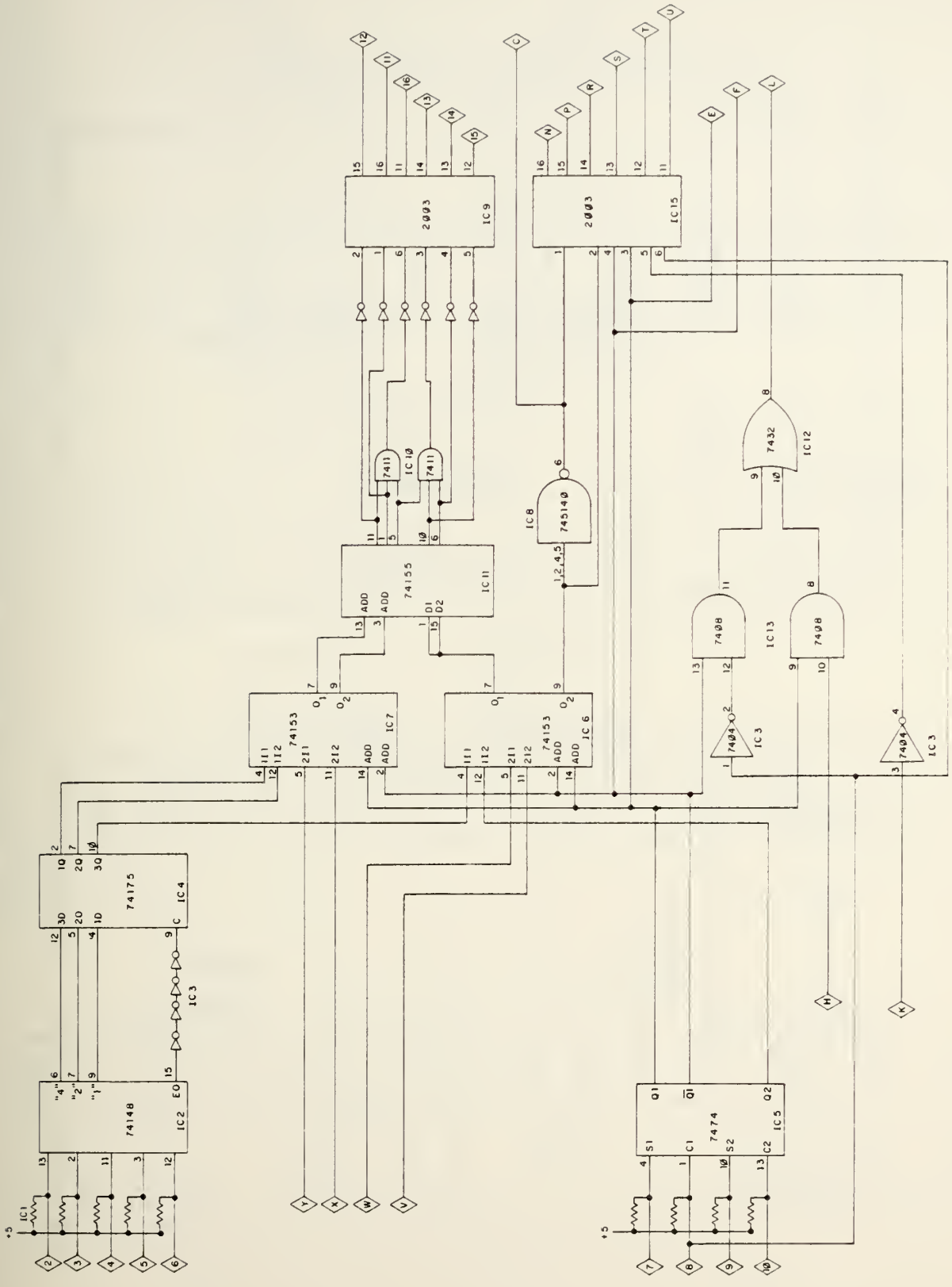


Figure 5 - Control Board PLL-11

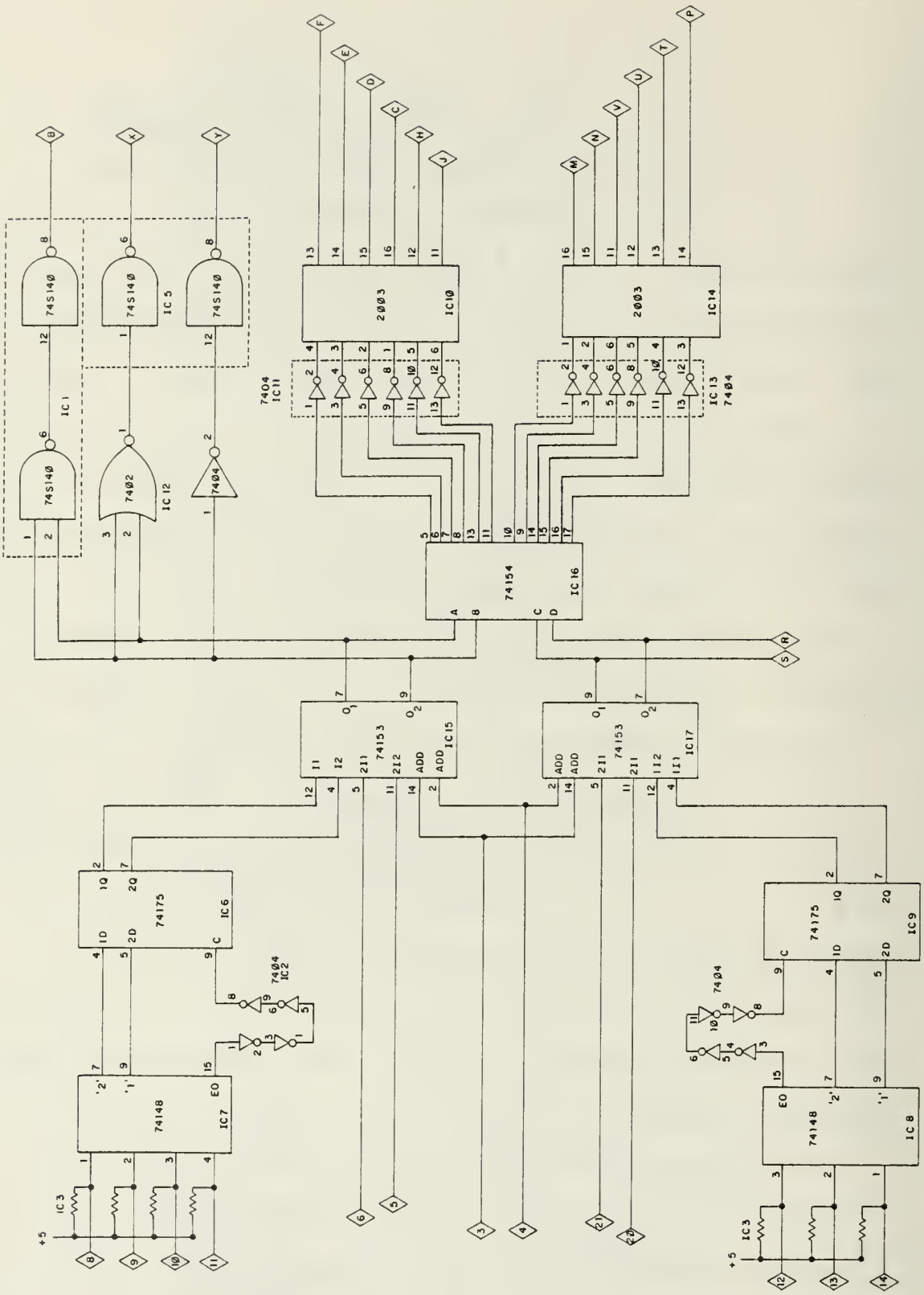


Figure 6 - Control Board PLL-12

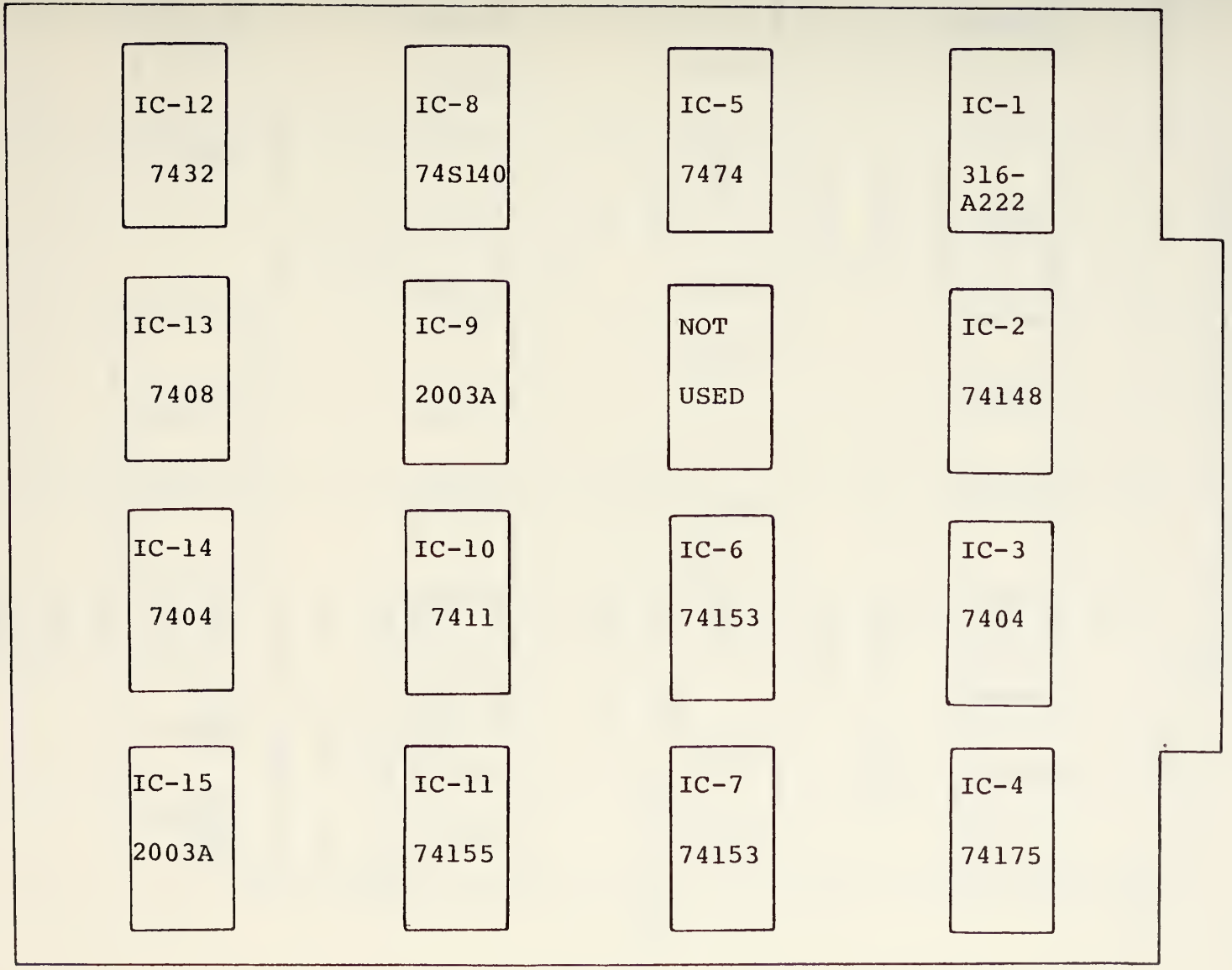


Figure 7 - Control Board PLL-11 Component Layout

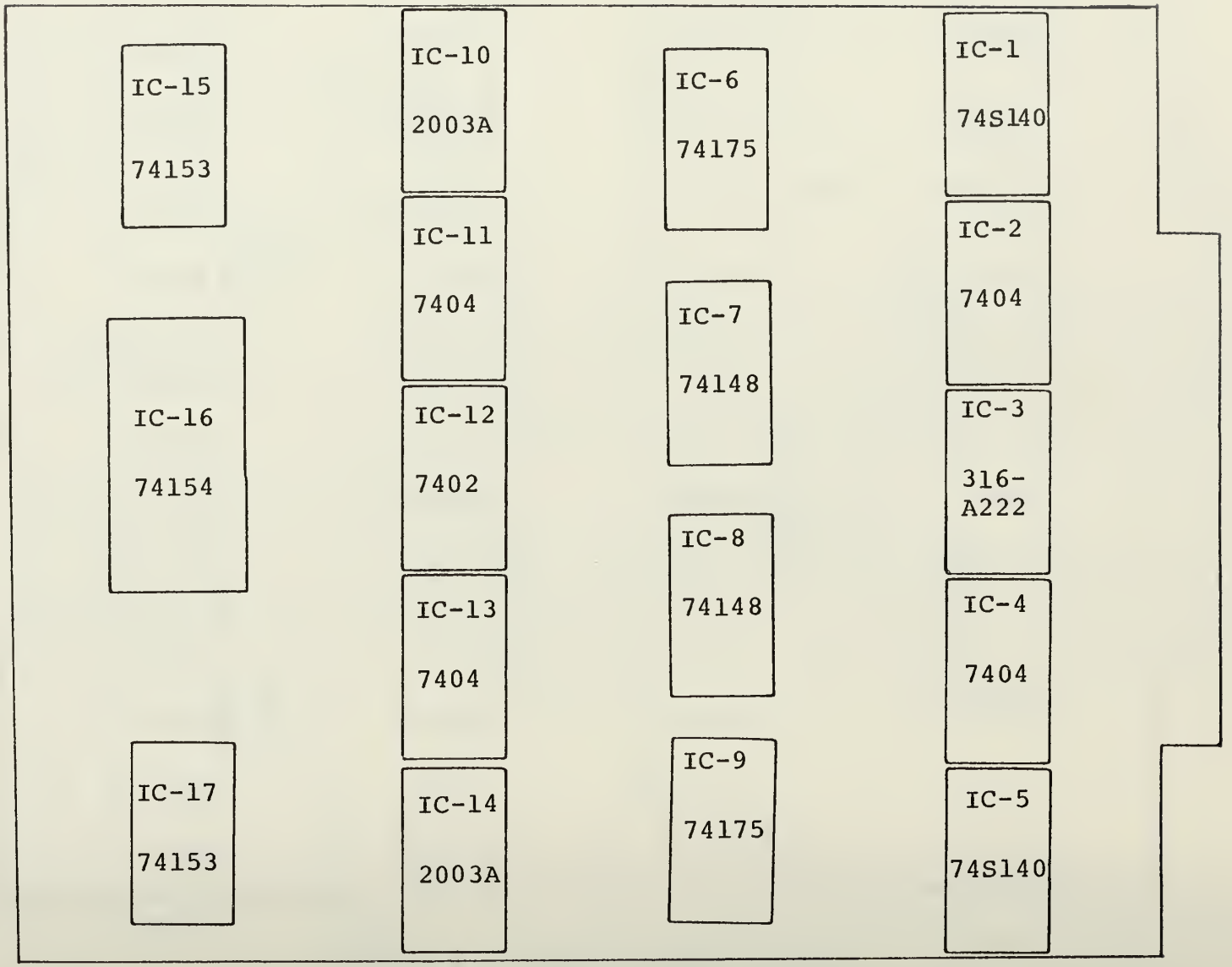


Figure 8 - Control Board PLL-12 Component Layout

TABLE I - PLL11 PIN CONNECTIONS

PIN	TO	PIN	TO
1	+5	A	+5
2	30 KHZ SW.	B	+28
3	10 KHZ SW.	C	PLL4 "CON"
4	3 KHZ SW.	D	N/C
5	1 KHZ SW.	E	J9p10, PLL12-3
6	.2 KHZ SW.	F	PLL12-4
7	REMOTE SW.	H	J9p32
8	LOCAL SW.	J	N/C
9	NORM SW.	K	PLL4 "CD", J9p3, J9p9
10	SQ. SW.	L	PLL5, 6, 7
11	S1-1, S2-1	M	+28
12	S1-2, S2-2	N	SQ. LIGHT
13	S1-3, S2-3	P	NORM LIGHT
14	S3-2, S4-2	R	REMOTE LIGHT, J10p1
15	S3-3, S4-3	S	LOCAL LIGHT, J10p3
16	S3-1, S4-1	T	UNLOCK LIGHT, J10p5
17	N/C	U	LOCK LIGHT, J10p7
18	N/C	V	J9p16
19	N/C	W	J9p17
20	N/C	X	J9p18
21	N/C	Y	J9p19
22	GND	Z	+28, +5 RET

TABLE II - PLL12 PIN CONNECTIONS

FROM	TO	FROM	TO
1	+5	A	+5
2	N/C	B	PLL5, 6, 7-K3
3	PLL11-E	C	VC02-3 LIGHT
4	PLL11-F	D	VC02-10 LIGHT
5	J9p35	E	VC02-30 LIGHT
6	J9p34	F	VC02-100 LIGHT
7	N/C	H	VC01-.3 LIGHT
8	VC01-.3/VC02-3/VC03-10	J	VC01-1 LIGHT
9	VC01-1/VC02-10/VC03-30	K	N/C
10	VC01-3/VC02-30/VC03-100	L	+28
11	VC01-10/VC02-100/VC03-300	M	VC01 3 LIGHT
12	ALL VC03	N	VC01 10 LIGHT
13	ALL VC02	P	VC03 10 LIGHT
14	ALL VC01	R	PLL9 (S1)
15	N/C	S	PLL9 (S0)
16	N/C	T	VC03-30 LIGHT
17	N/C	U	VC03-100 LIGHT
18	N/C	V	VC03-300 LIGHT
19	N/C	W	N/C
20	J9p37	X	PLL5, 6, 7-K1
21	J9p36	Y	PLL5, 6, 7-K2
22	GND	Z	GND

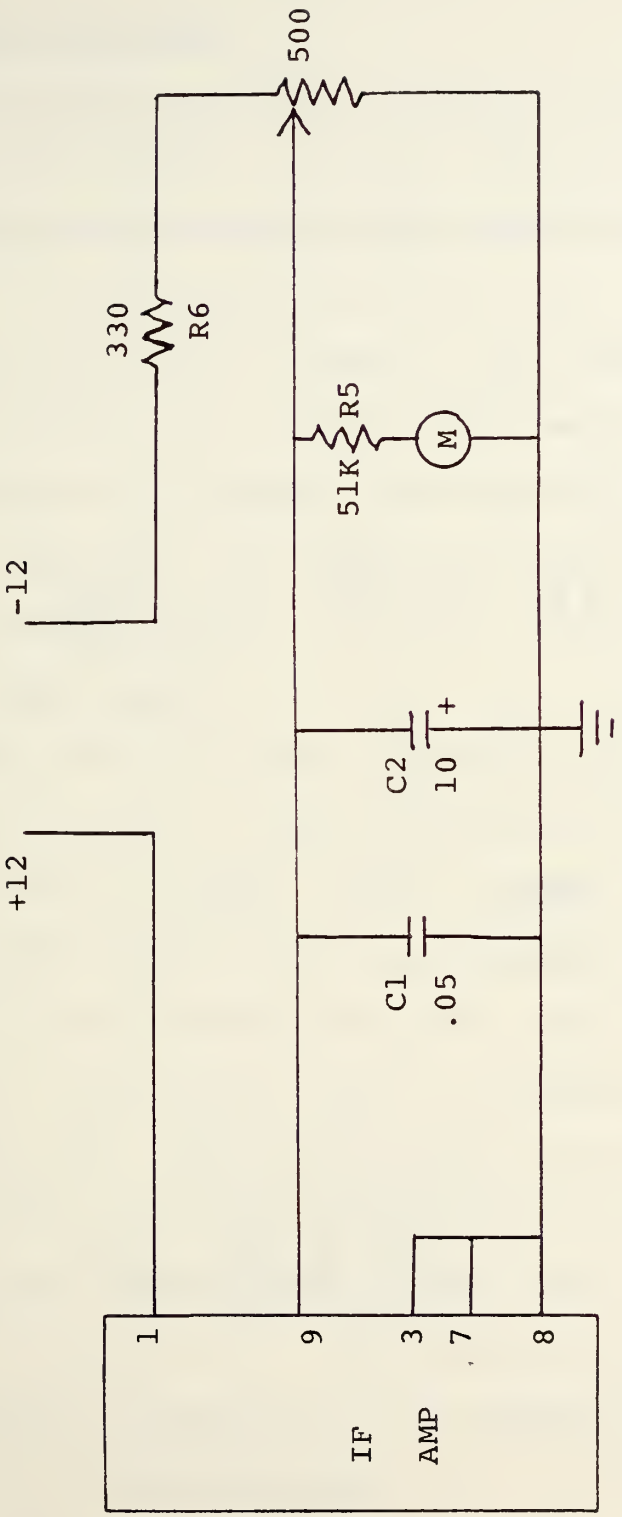


Figure 9 - Manual Gain Control

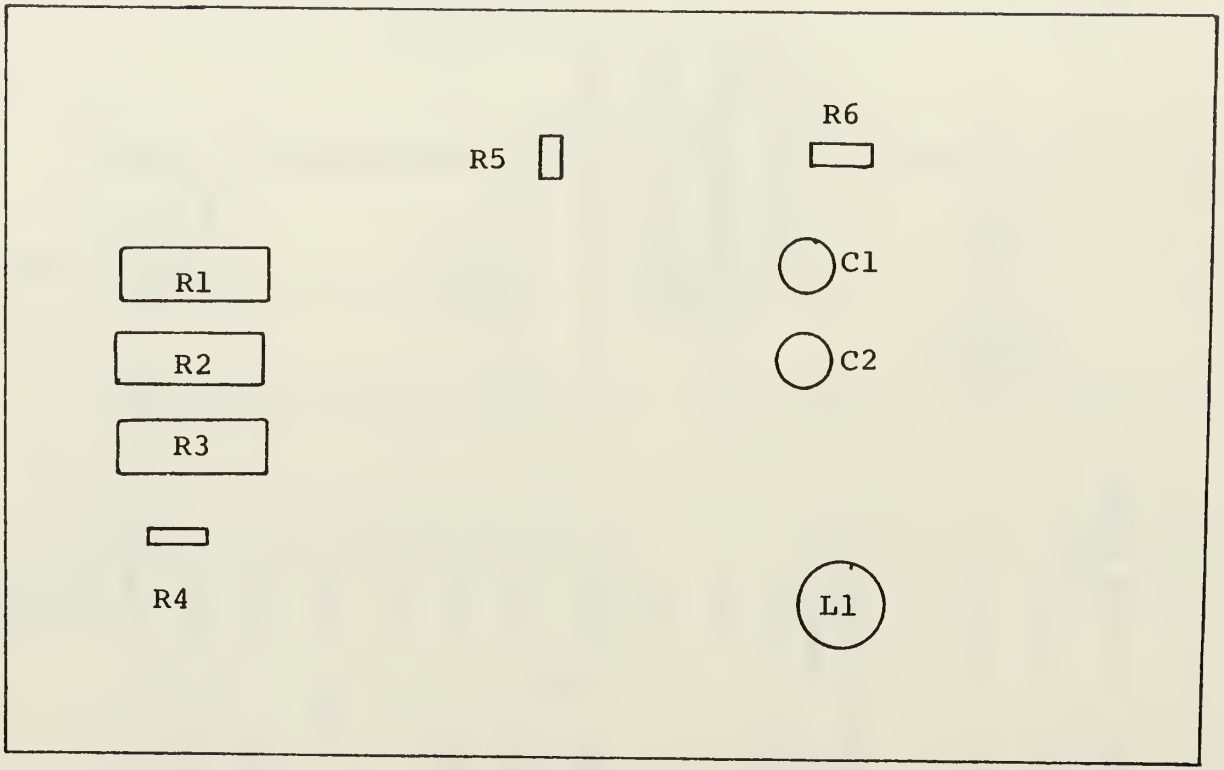


Figure 10 - MGC Board Component Layout

3. Coaxial Switching

As previously covered, the coaxial switch operation is handled by the control circuits. The indicators for IF bandwidth are operated through the coaxial switches as shown in Figure 11. The additional indicator (L1), which is physically on the MGC board, is added to show when the switching has taken place (i.e., if L1 is ON then S1, S2, S3, and S4 have switched to the appropriate position). This was done to eliminate any doubt about whether or not a switch was at fault when troubleshooting.

4. Lamp Test Circuit

A lamp test switch was installed on the front panel of A6 in order to monitor the indicators for failure. This switch has to do two things. First, it must interface with the existing IFBW coaxial switching and indicator circuit, and second, it must interface with the lamp drivers on the control boards. The circuit used to accomplish this is shown in Figure 12. Due to the current surge when testing all lamps, current limiting resistors were added to the 28 volt supply line. These resistors are physically located on the MGC board (R1, R2, R3). The steering diodes used with the IFBW switches are mounted on the respective switches.

5. Additional Amplification

Initial tests showed that the received signal level at the hard limiter was not sufficiently high to saturate the hard limiter. For this reason, another stage of amplification

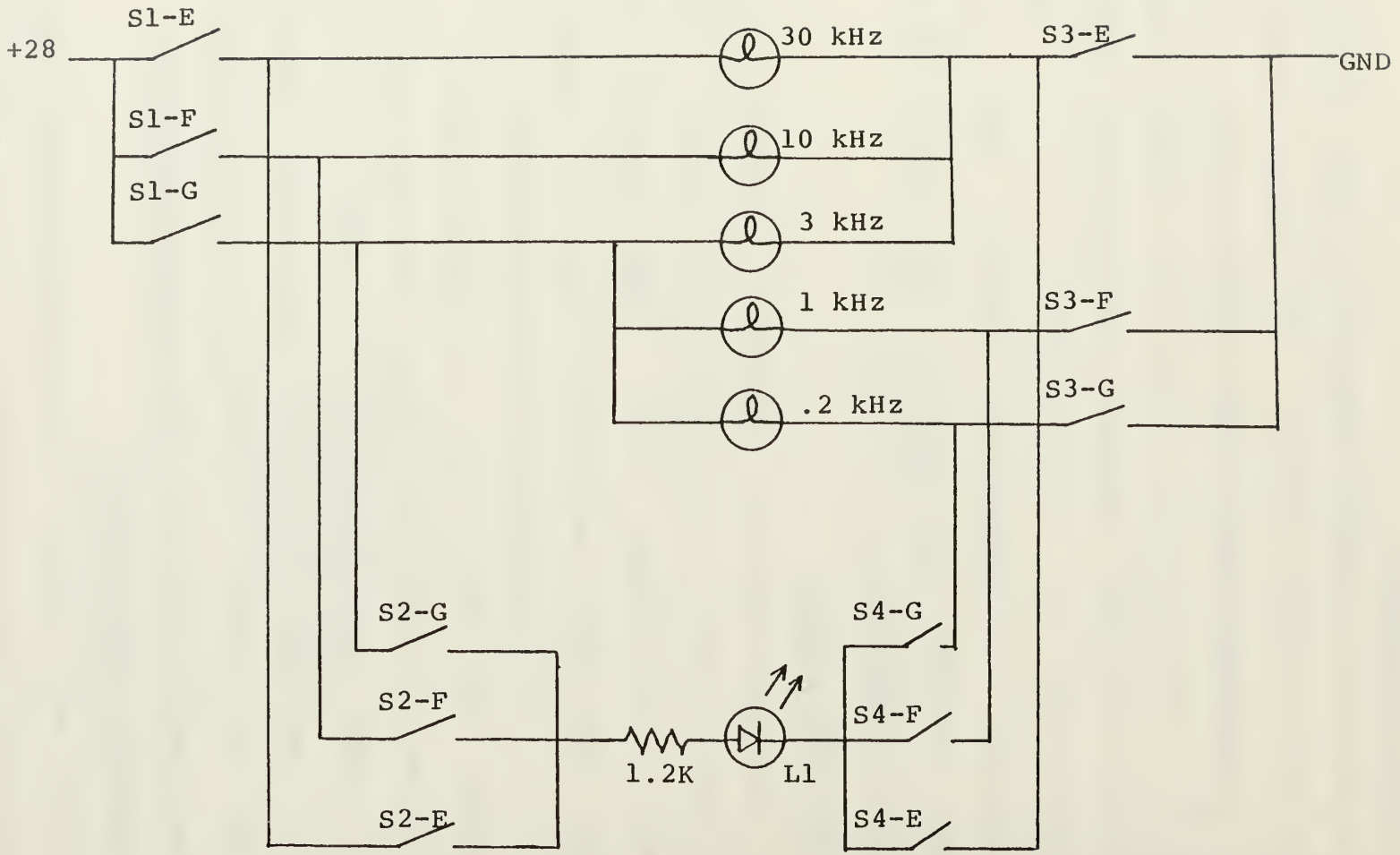


Figure 11 - IF Bandwidth Coaxial Switching

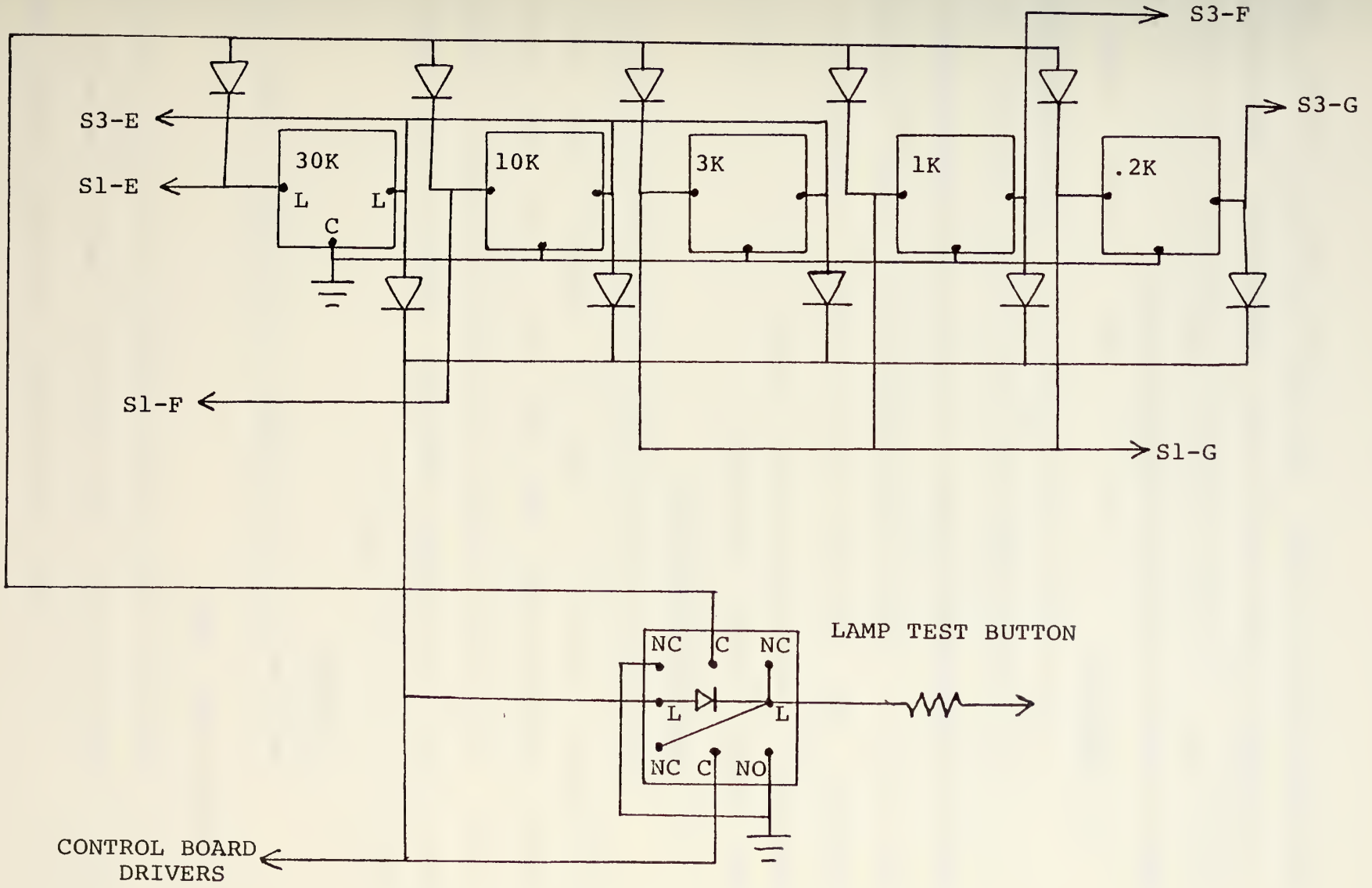


Figure 12 - Receiver Lamp Test Circuit

was added at the IF level. The amplifier used is a Watkins-Johnson model number 6200-352 which provides an additional 28 db of gain. A second additional amplifier (12 db) was added in the RF group for the same reason.

6. Splitter

An Anzac THV-50 power splitter was added immediately following the first mixer in order to provide a second input path to the AN/WSC-3 Receiver. By properly processing any input signal, it can be converted for use on one of the WSC-3 channels. Thus, the WSC-3 can now be used to demodulate a signal which was originally not transmitted at one of the WSC-3 channel center frequencies.

7. Minor Modifications

Other minor modifications to the existing receiver circuits are tabulated in Table III. Tables IV and V list the pin connections for back panel plugs J9 and J10 respectively. These plugs provide the interconnections to control panel C2 and the Interdata computer. Figure 13 is a wiring diagram for the front panel.

8. Alignment

The LFBW and VCO alignment is outlined in Table VI.

C. OPERATIONAL TESTS

All switching functions and the ability to lock on and track a received signal were tested and found to be satisfactory. A test scheme was developed and used to verify the

actual bandwidth using the various loop filter and IF filter combinations. The results of the tests showed the actual bandwidth to be very near the selected bandwidth. A computer simulator was used to test the remote operation capability of the control circuits. Again the results of the test were satisfactory.

At this point the receiver was judged complete and operating as designed. Therefore, the project moved to step two, the Primary Receiver Control Panel (C2).

TABLE III - MINOR RECEIVER MODIFICATIONS

PC BOARD	MINOR MODIFICATIONS
ALL	Add power supply filter capacitors as necessary.
PLL 1	Change R1 to 20K pot. for meter adjust.
PLL 2	Change R9 to 5K pot. for meter adjust. Change R3 to 4.7K, R4 to 39 and R5 to 1.8K due to design error.
PLL 3	Change R5 to 5K pot. for meter adjust. Change R3 to 4.7K, R4 to 39 and R5 to 1.8K due to desing error. Remove R7 and replace with short.
PLL 5, 6, 7	Add power to Pin 13 of IC2.
PLL 9	GND enable on IC1. Change R1 to 1K and R2 to 510. Individually GND each VCO and bypass each VCO PS connection.
Front Panel	Change AUTO button to read REMOTE. Change MAN button to read LOCAL.
PLL 2, 3	Add .1 ufd capacitor between wiper arm of P1 and GND.

TABLE IV - J9 PIN CONNECTIONS

PIN	FROM	TO
1	+ 5 RET	+ 5 RET
2	N/C	
3	PLL11-K	OP.BD.A SATNO
4-8	N/C	
9	PLL11-K	OP.BD.A SIN 050
10	PLL11-E, PLL12-4	OP.BD.A SIN 070
11-15	N/C	
16	PLL11-V	OP.BD.A DOT 060
17	PLL11-W	OP.BD.A DOT 040
18	PLL11-X	OP.BD.A DOT 020
19	PLL11-Y	OP.BD.A DOT 000
20	+ 5 RET	+ 5 RET
21-31	N/C	
32	PLL11-H	OP.BD.A COT 070
33	N/C	
34	PLL12-6	OP.BD.A DOT 070
35	PLL12-5	OP.BD.A DOT 050
36	PLL12-21	OP.BD.A DOT 030
37	PLL12-20	OP.BD.A DOT 010
38-49	N/C	
50	+ 5	+ 5

TABLE V - J10 PIN CONNECTIONS

PIN	FROM	TO
1	A6 PLL11-R	C2 'REMOTE' LIGHT
2	A6 'WSC 3 NORM' LIGHT	C2 'WSC 3 NORM' LIGHT
3	A6 PLL11-S	C2 'LOCAL' LIGHT
4	A6 'WSC 3 OFFSET' LIGHT	C2 'WSC 3 OFFSET' LIGHT
5	A6 PLL11-T	C2 'UNLOCK' LIGHT
6	N/C	
7	A6 PLL11-U	C2 'LOCK' LIGHT
8-24	N/C	

TABLE VI - LOOP FILTER AND VCO ALIGNMENT PROCEDURES

LOOP FILTER ALIGNMENT (PLL 5,6,7)

1. Connect oscilloscope to the output terminals of the appropriate board (PLL 5,6or7).
2. Place the loop filter board input switch in the 'SHORT' position.
3. Place the loop filter board integrating capacitor switch in the 'SHORT' position.
4. Observe oscilloscope and adjust P1 for a 0 vdc level at the output of the loop filter board.

VCO ALIGNMENT (PLL 9)

1. Short the input to the VCO to be aligned (VCO 1,2,or3) by shorting the output of the appropriate loop filter board (PLL 5, 6 or 7). DO NOT SHORT ACROSS R2 AT THE VCO INPUT.
2. While observing the HP frequency counter (immediately below the receiver) adjust the VCO rest frequency to 950 kHz. PLL 9 must be removed and turned upside down to make this adjustment.

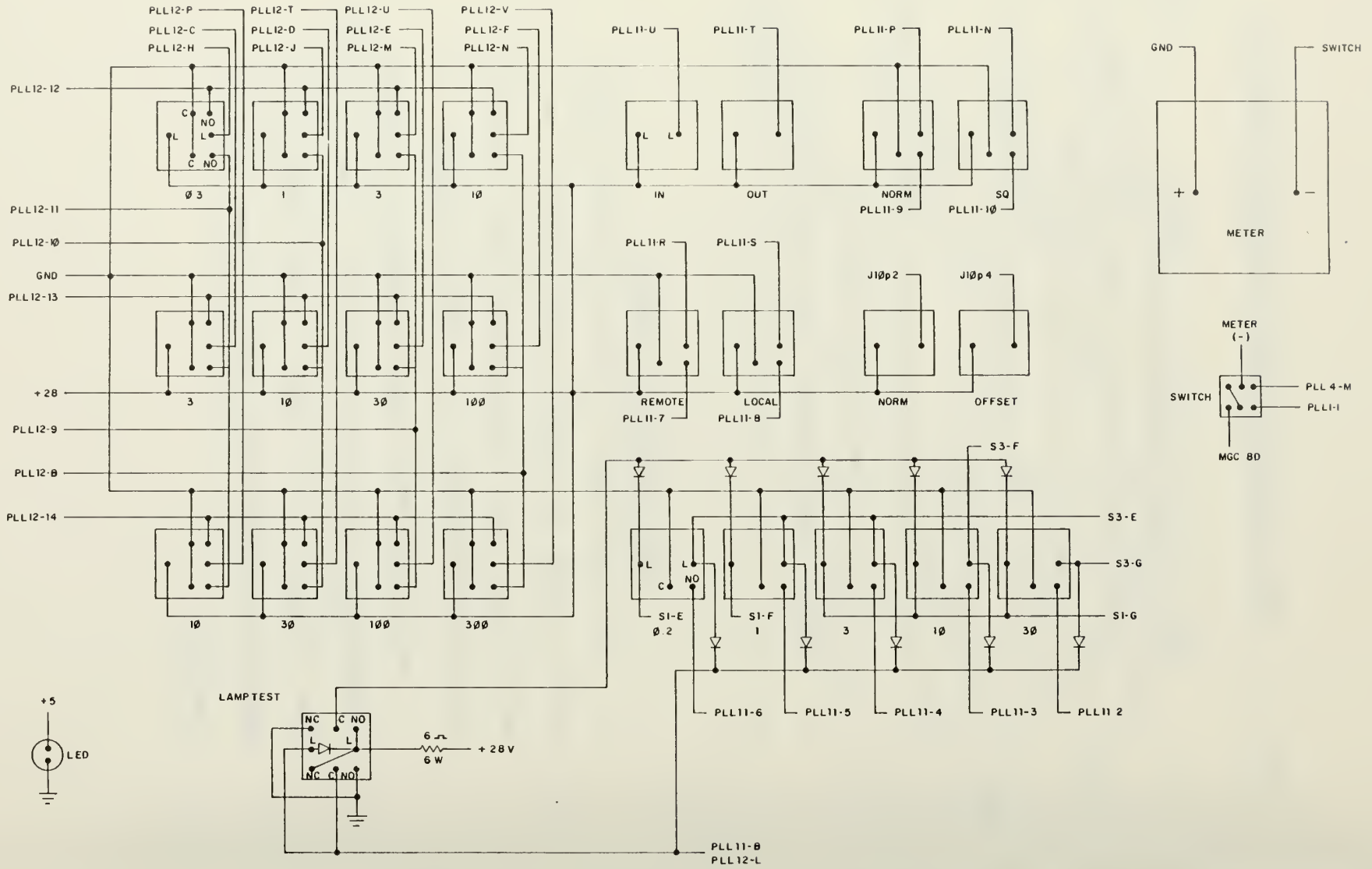


Figure 13 - Receiver Front Panel Wiring

III. RECEIVER CONTROL PANEL C-2

A. GENERAL

The receiver control panel (C2) is located in equipment rack 8 and is made up of fifty-four momentary pushbutton switches and indicators. Its purpose is to allow remote operation of the Primary Receiver (A6) from the operator's console. The control panel duplicates all of the receiver front panel controls and in addition it provides for selection of a satellite, channel number or center frequency, and mode of operation of the system. The panel layout is shown in Figures 14 and 15. Figure 16 is a wiring diagram for the panel.

B. CONTROL PANEL CIRCUIT BOARDS

There are two circuit boards associated with the control panel. They are the Matrix Board which establishes a unique address for each control panel switch and the Light Board which drives the control panel indicators. The general design concept for these is covered in Reference 11. The schematics for these circuits are shown in Figures 17 and 18. Figures 19 and 20 show the component layout and Tables VII and VIII the pin connection for the circuit boards. Figure 21 shows the switch addresses generated by the Matrix Board and Figure 22 identifies the associated indicator lamps.

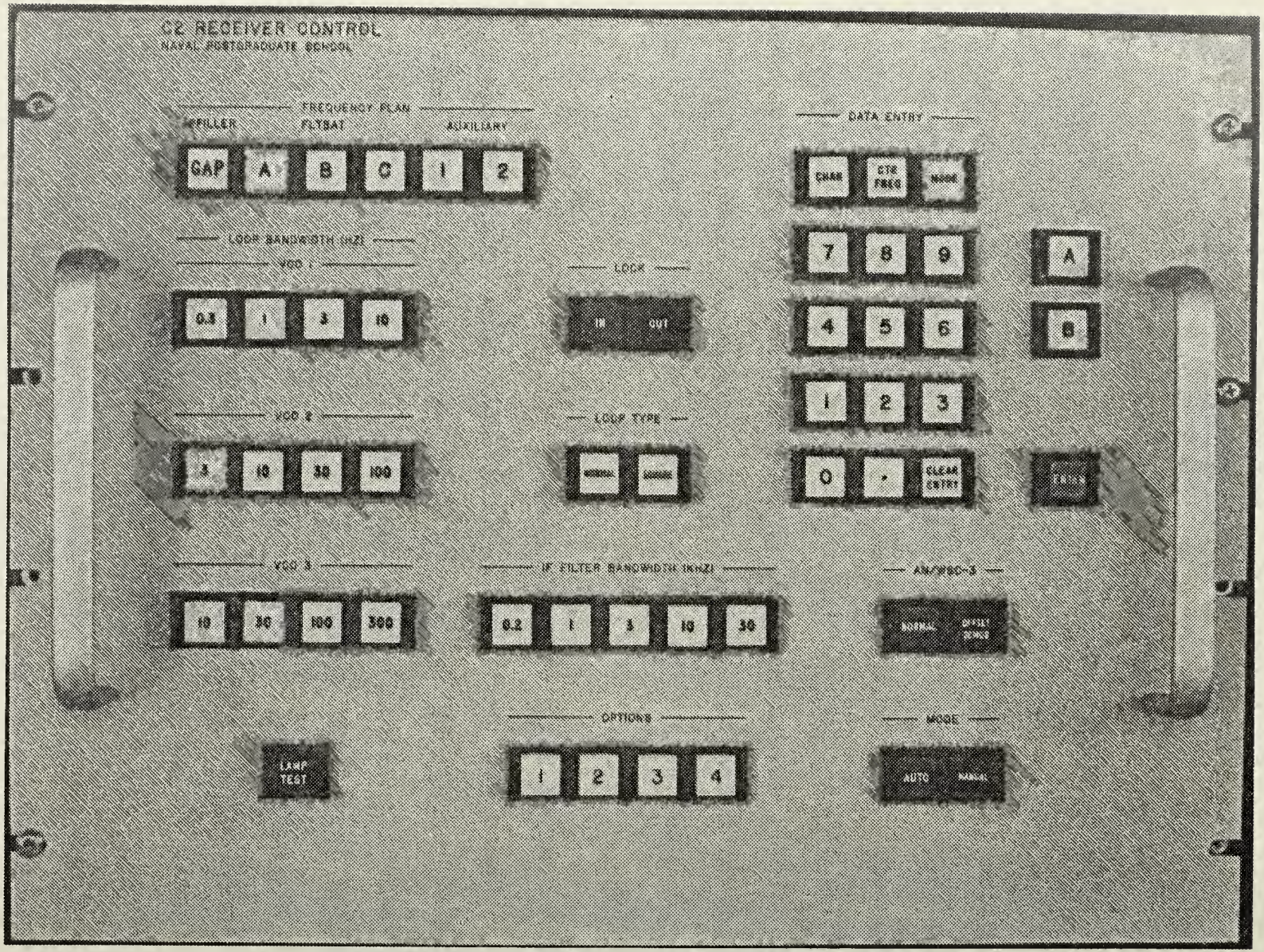


Figure 14 - Control Panel Photograph

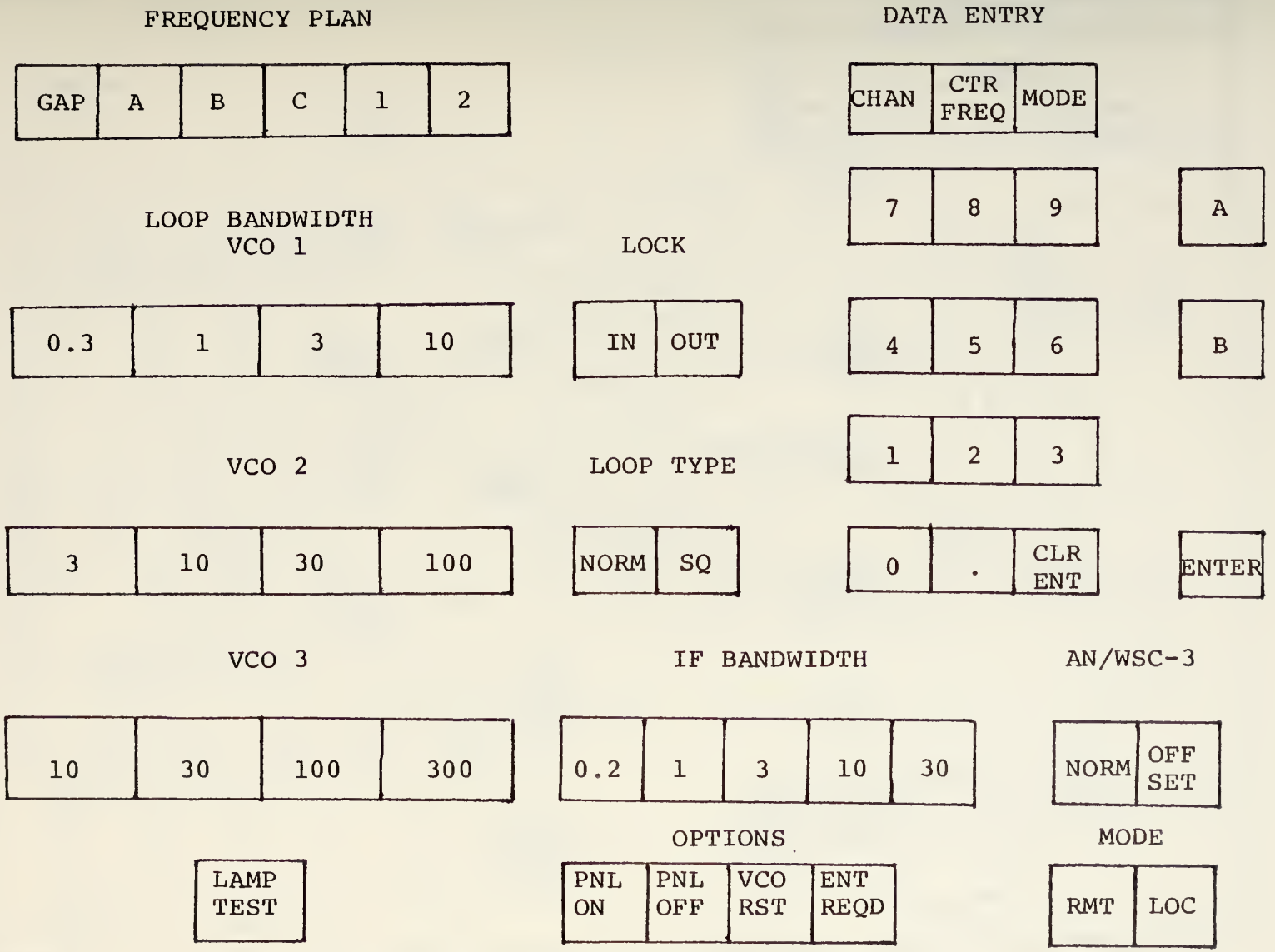


Figure 15 - Control Panel C2 Layout

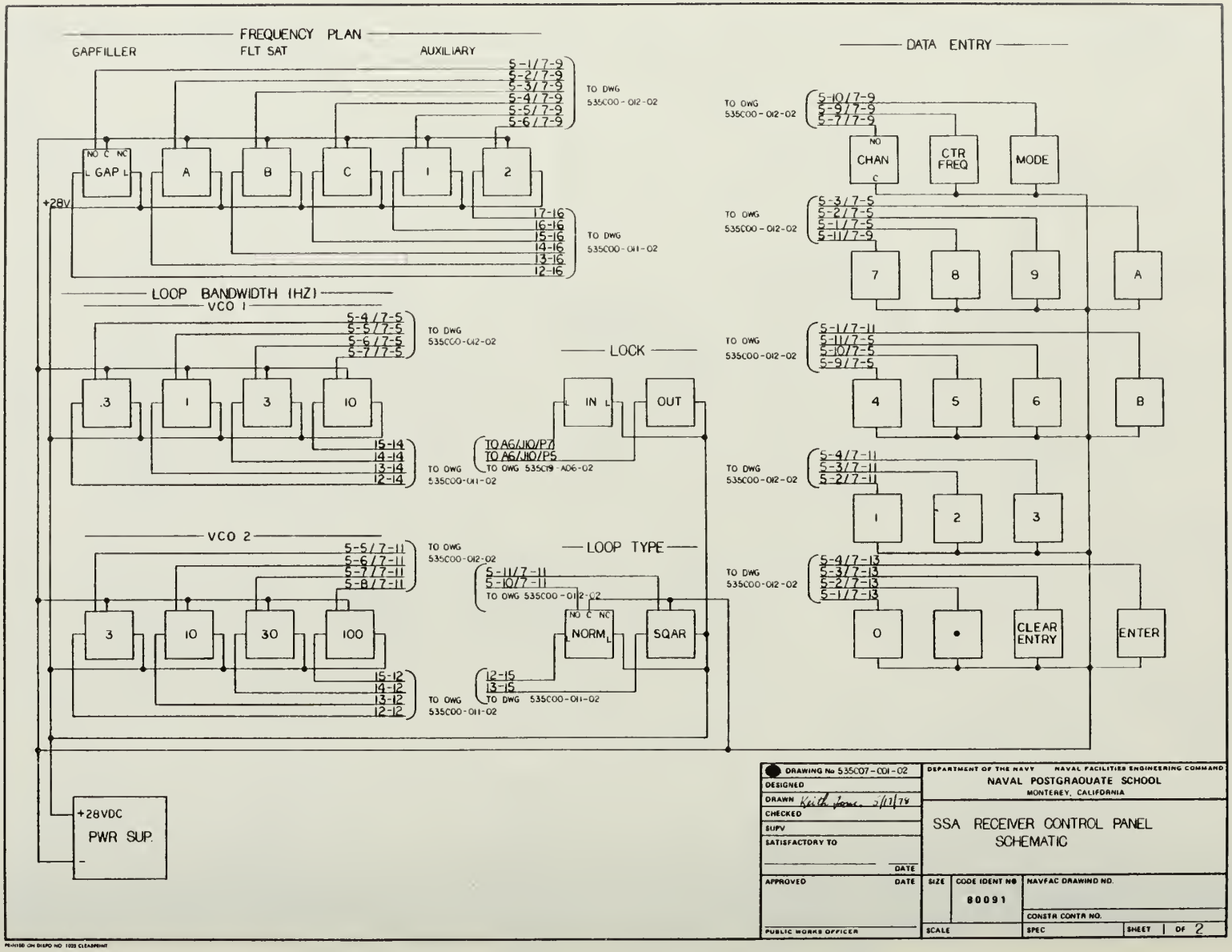


Figure 16a - Control Panel Wiring Diagram (Upper)

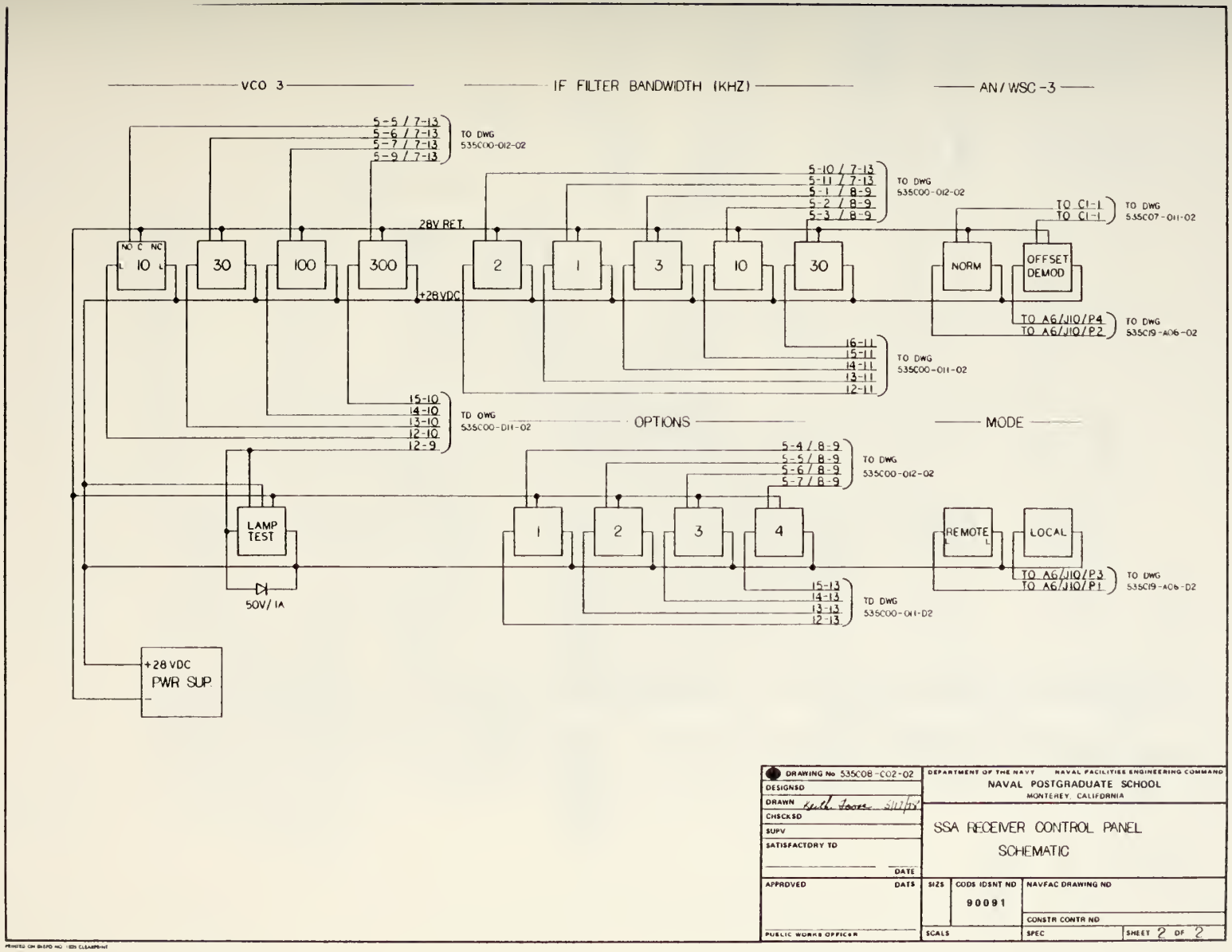


Figure 16b - Control Panel Wiring Diagram (Lower)

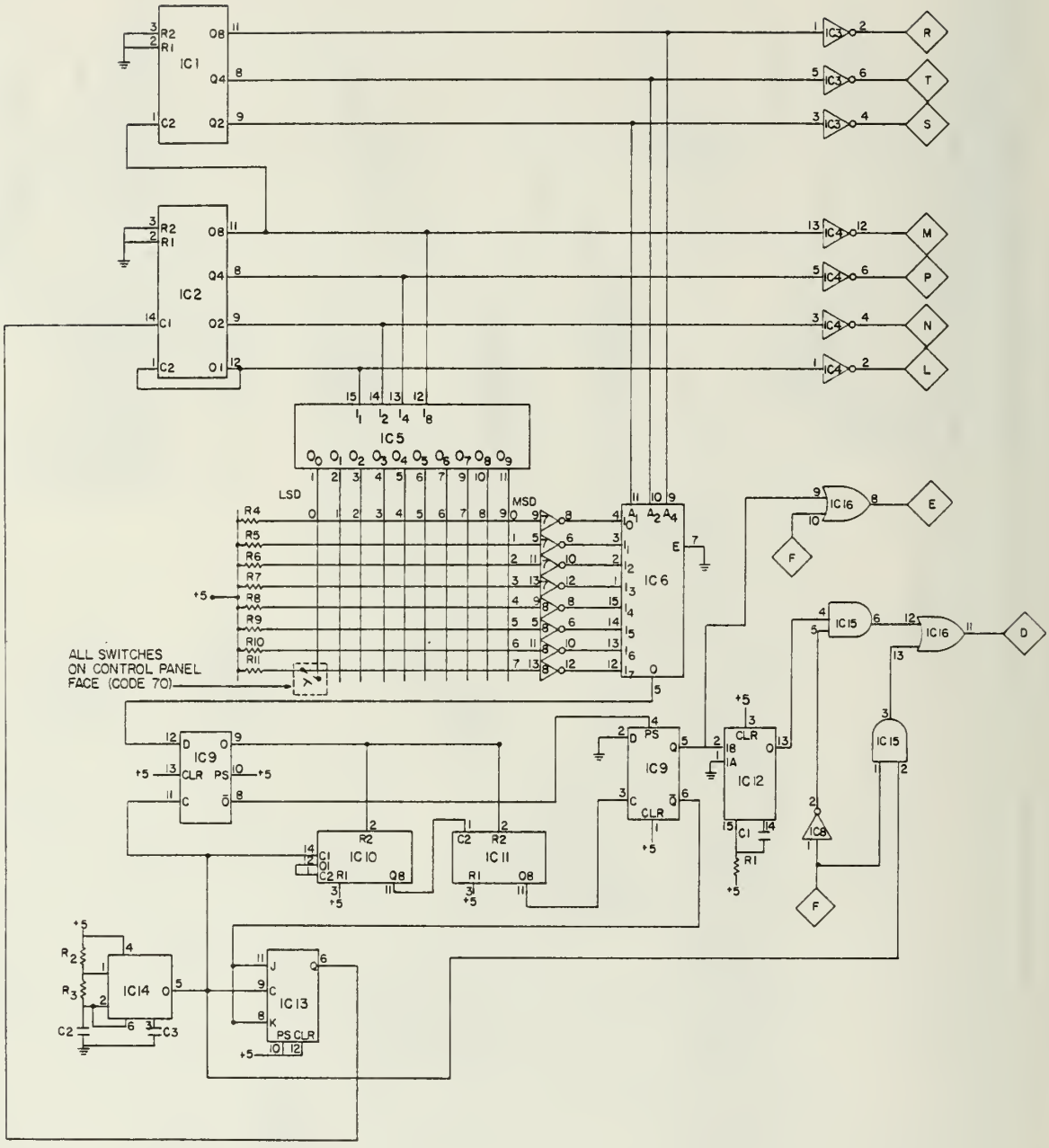


Figure 17 - Control Panel Matrix Board

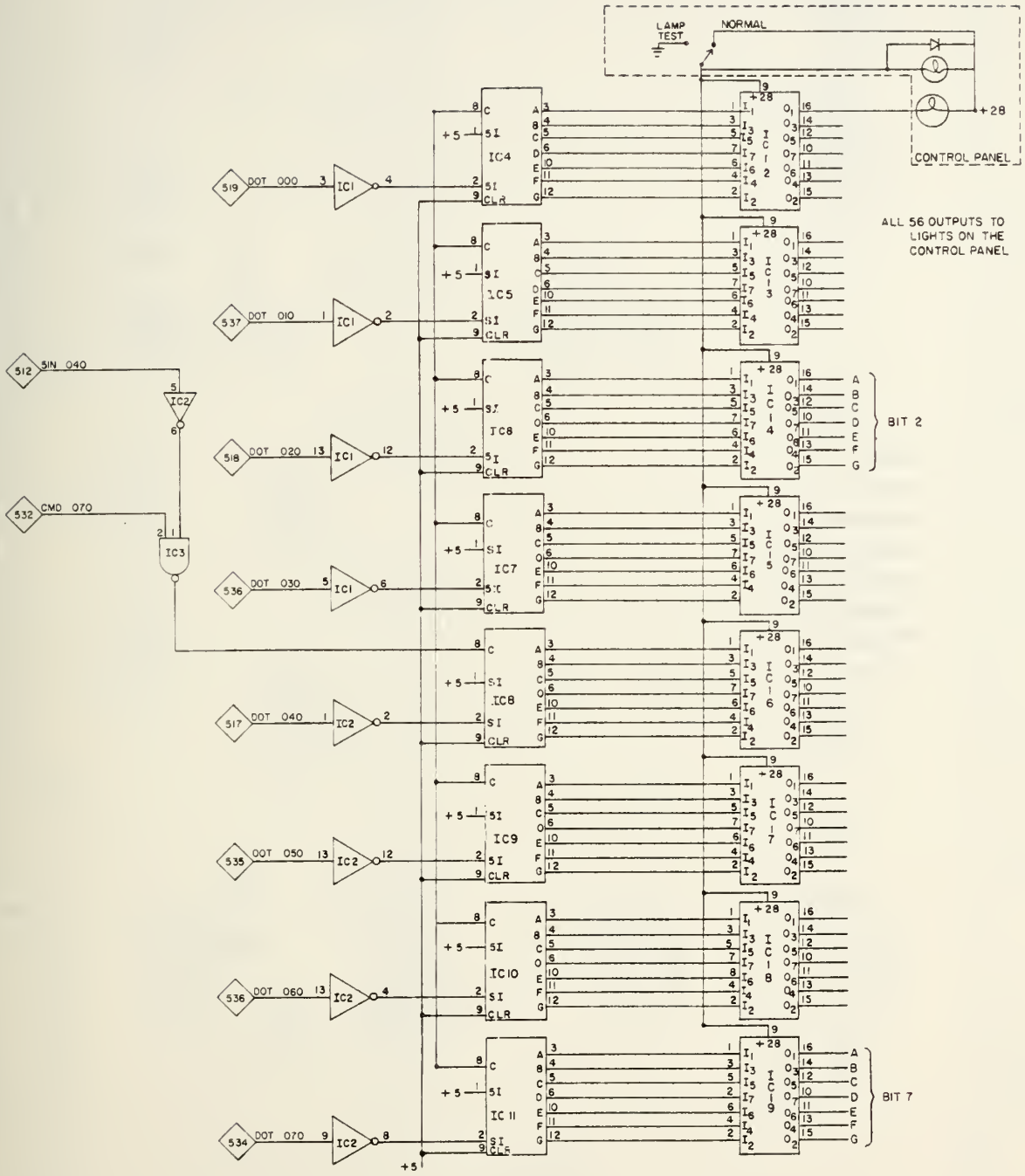


Figure 18 - Control Panel Light Board

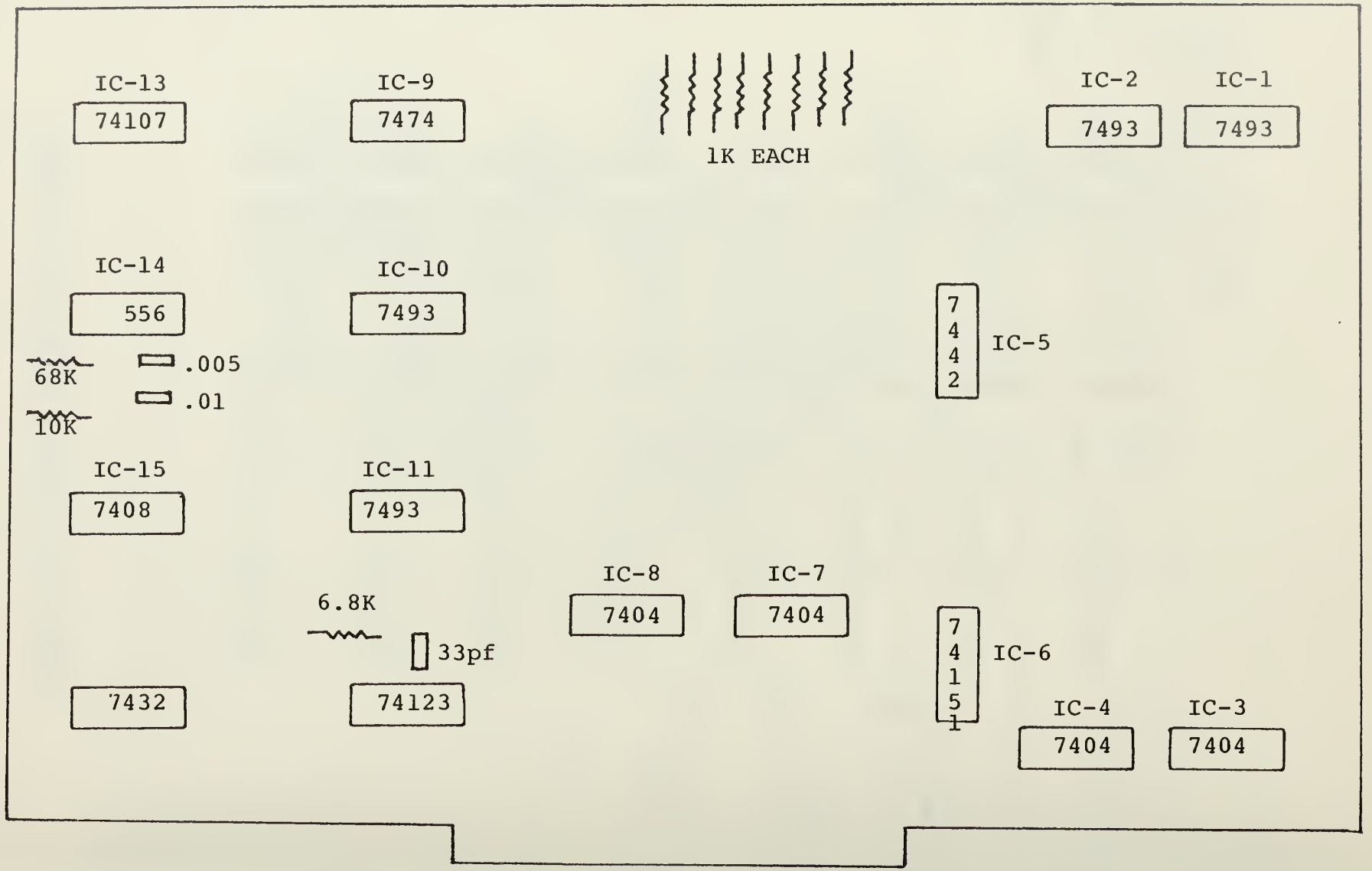


Figure 19 - Control Panel Matrix Board Component Layout

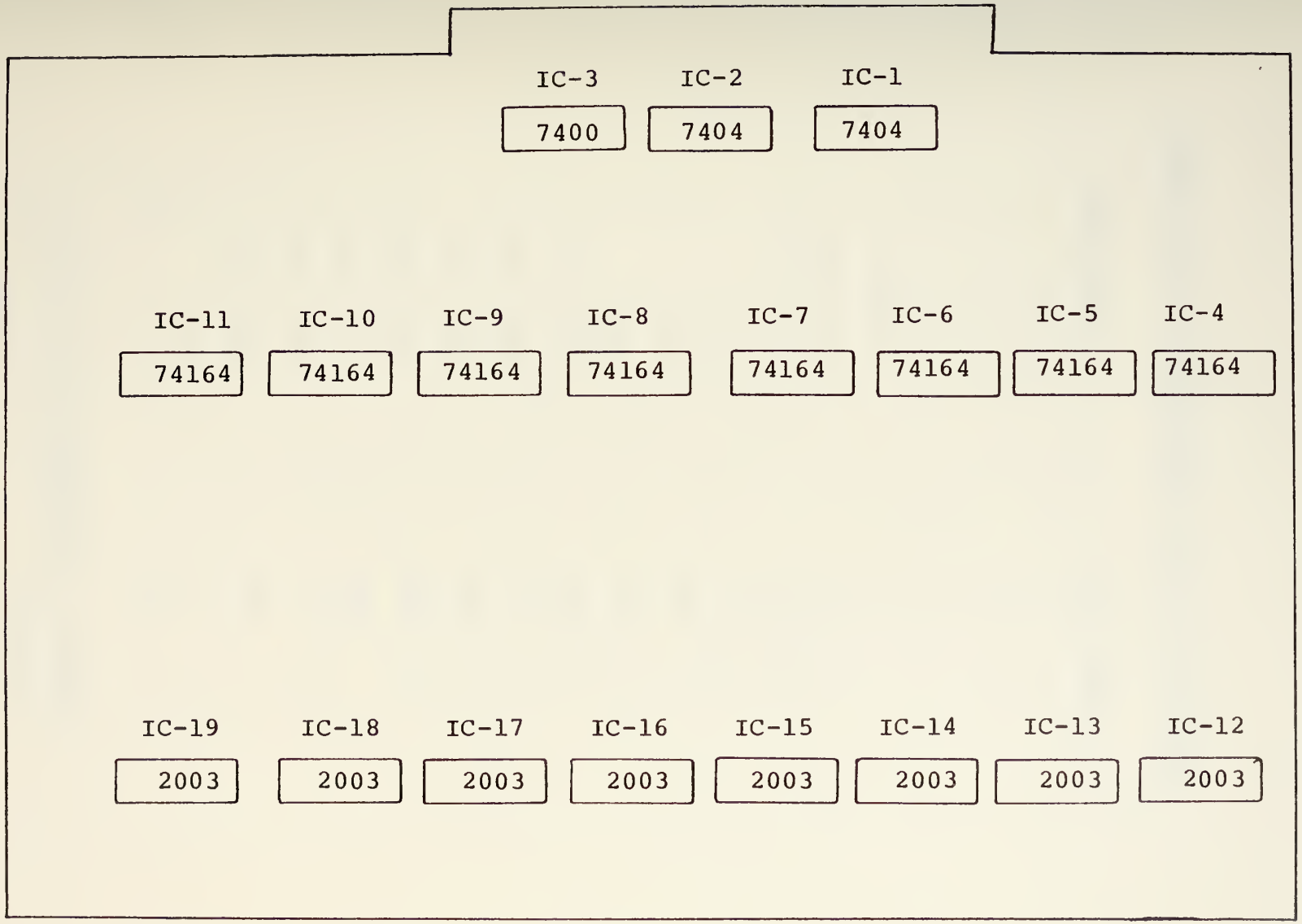


Figure 20 - Control Panel Light Board Component Layout

TABLE VII - MATRIX BOARD PIN CONNECTIONS

Pin	Function
A	+5 v
B	+5 v
C	N/C
D	SATNO
E	SIN 040
F	CMD 070
H	N/C
J	N/C
K	N/C
L	DIN 070
M	DIN 040
N	DIN 060
P	DIN 050
R	DIN 010
S	DIN 030
T	DIN 020
U	+5 v
V	+5 v
Opposite Side (Top)	
1-18	Ground

TABLE VIII - LIGHT BOARD PIN CONNECTIONS

Pin	Function
1	+28 v
2	+28 v
3	+5 v
4	+5 v
5	N/C
6	DOT 000
7	DOT 010
8	DOT 020
9	DOT 030
10	DOT 040
11	DOT 050
12	DOT 060
13	DOT 070
14	DAGO
15	CMD 070
16	N/C
17	N/C
18	N/C
Opposite Side (Bottom)	
A-V	Ground

Column	0000 0	0001 1	0010 2	0011 3	0100 4	0101 5	0110 6	0111 7	1000 8	1001 9	LOW ORDER
000 0	GAP	A	B	C	1	2	CHAN	CTR FREQ	MODE	7	
001 1	8	9	A	0.3	1	3	10	4	5	6	
010 2	B	1	2	3	3	10	30	100	NORM	SQ	
011 3	0	.	CLEAR ENTRY	ENTER	10	30	100	300	0.2	1	
100 4	3	10	30	PANEL ON	PANEL OFF	VCO RESET	ENTRY REQD				
101 5											
110 6											
111 7											

HIGH ORDER

Figure 21 - Control Panel Switch Address Identification

BIT / BYTE	0	1	2	3	4	5	6	7
G	NORM	SQUARE						
F	PANEL ON	PANEL OFF	VCO RESET	ENTRY REQD				
E	0.2	1	3	10	30			
D	10	30	100	300				
C	3	10	30	100				
B	0.3	1	3	10				
A	GAP	A	B	C	1	2		

Figure 22 - Control Panel Indicator Lamp Identification

C. CONTROL PANEL OPERATION

The purpose of control panel C2 is to provide a remote control location, at the SATCOM Signal Analyzer operator's console, for control of the Primary Receiver (A6). The control panel buttons are grouped into six catagories with the following functions: (1) reciever action, (2) satellite frequency plan selection, (3) type of data to be entered, (4) numerical data entry, (5) options, and (6) operator information indicators.

1. Receiver Action Buttons

There are nineteen buttons in this category and their sole purpose is to duplicate the receiver front panel controls. This is done by providing the appropriate control data, via the computer, to PLL11 and PLL12 of the receiver.

2. Satellite Frequency Plan Selection

There are six buttons of this type whose purpose is to choose a predetermined frequency plan. Four of these buttons are functional, the other two are for future use only. The frequency plans currently in use are shown in Tables IX and X.

3. Data Entry Buttons

These three buttons specify what type of numerical data is about to be entered. They are used in conjunction with the Numerical Entry Buttons and have no real meaning if used alone. The possible data types are a channel number, frequency, or mode of operation.

TABLE IX - GAPFILLER FREQUENCY PLAN

Channel	Uplink	Downlink
1	302.450	248.850
2	302.475	248.875
3	302.500	248.900
4	302.525	248.925
5	302.550	248.950
6	302.575	248.975
7	302.600	249.000
8	302.625	249.025
9	302.650	249.050
10	302.675	249.075
11	302.700	249.100
12	302.725	249.125
13	302.750	249.150
14	302.775	249.175
15	302.800	249.200
16	302.825	249.225
17	302.850	249.250
18	302.875	249.275
19	302.900	249.300
20	302.925	249.325
A	307.750	254.150
B	311.150	257.550

TABLE X - FLTSAT FREQUENCY PLAN

Channel	Plan	Uplink	Downlink
1	A	SHF	250.45
	B	Spread Spectrum	250.55
	C		250.65
2	A	292.95	251.95
	B	293.05	252.05
	C	293.15	252.15
3	A	294.65	253.65
	B	294.75	253.75
	C	294.85	253.85
4	A	296.35	255.35
	B	296.45	255.45
	C	296.55	255.55
5	A	297.95	256.95
	B	298.05	257.05
	C	298.15	257.15
6	A	299.45	258.45
	B	299.55	258.55
	C	299.65	258.65
7	A	306.35	265.35
	B	306.45	265.45
	C	306.55	265.55
8	A	307.85	266.85
	B	307.95	266.95
	C	308.05	267.05
9	A	309.25	268.25
	B	309.35	268.35
	C	309.45	268.45
10	A	310.75	269.75
	B	310.85	269.85
	C	310.95	269.95
11	A	317.045	243.945
	B	317.145	244.045
	C	317.245	244.145
12	A	317.055	243.955
	B	317.155	244.055
	C	317.255	244.155

TABLE X - FLTSAT FREQUENCY PLAN (con't)

Channel	Plan	Uplink	Downlink
13	A	317.060	243.960
	B	317.160	244.060
	C	317.260	244.160
14	A	317.065	243.965
	B	317.165	244.065
	C	317.265	244.165
15	A	317.070	243.970
	B	317.170	244.070
	C	317.270	244.170
16	A	317.075	243.975
	B	317.175	244.075
	C	317.275	244.175
17	A	317.080	243.980
	B	317.180	244.080
	C	317.280	244.180
18	A	317.085	243.985
	B	317.185	244.085
	C	317.285	244.185
19	A	317.090	243.990
	B	317.190	244.090
	C	317.290	244.190
20	A	317.095	243.995
	B	317.195	244.095
	C	317.295	244.195
21	A	317.100	244.000
	B	317.200	244.100
	C	317.300	244.200
22	A	317.110	244.010
	B	317.210	244.110
	C	317.310	244.210
23	A	294.200	260.600
	B	295.300	261.700
	C	295.900	262.300

4. Numerical Entry Buttons

There are fifteen buttons in this group (includes decimal point, clear entry, enter, A and B). After the data type is specified, these buttons are used to enter the actual data.

5. Option Buttons

There were originally four option buttons on the panel to be used for "unforseen needs". These have all been used and function as the "Panel On Control", "Panel Off Control", "VCO Reset", and "Entry Required" indicator.

6. Indicator Lamps

In addition to the switches on the control panel, there are seven operator information indicators. These are used to prompt the operator to take some action or merely to provide him with some necessary information.

A detailed description of each button and indicator and its function is contained in Table XI.

D. AN/WSC-3

The source of signal input to the AN/WSC-3 Receiver (used in a different section of the Satellite Communications Monitoring System) is selected at the C2 panel. In the "NORMAL" case, the signal goes from antenna to RF group to WSC-3. This is done when the received signal is at one of the WSC-3 channel frequencies. If the received signal is not directly on a WSC-3 channel frequency, and the WSC-3 is to be used,

TABLE XI - C2 BUTTON FUNCTIONS

Group	Name	Number	Function
1	VC01-ALL	13-16	Send control data to A6 to select VCO and LFBW. Light appropriate lamps on C2 and A6.
1	VC02-ALL	24-27	
1	VC03-ALL	34-37	
1	IFBW-ALL	38-42	Send control data to A6 to select IFBW. Light appropriate lamp on C2 and A6.
1	NORMAL	28	Send control data to A6 to select Loop Type. Light appropriate lamp on C2 and A6.
1	SQUARE	29	
2	GAP	00	Specify appropriate frequency plan and light the lamp on C2.
2	A	01	
2	B	02	
2	C	03	
2	1	04	Not used.
2	2	05	Not used.
3	CHAN	06	Specifies that subsequent numerical entry will be a channel number to be used with selected frequency plan. Light 'Entry Req'd' on C2.
3	CTR FREQ	07	Specifies that subsequent numerical entry will be a frequency in MHz. Light 'Entry Req'd' on C2.
3	MODE	08	Specifies that subsequent numerical entry will designate a preset mode of operation. Light 'Entry Req'd' on C2.

TABLE XI - C2 BUTTON FUNCTIONS (con't)

Group	Name	Number	Function
4	All numbers letters and decimal	09-12 17-23 30-31	Load the value of the button in a register.
4	CLEAR ENTRY	32	Load zeros in the number register.
4	ENTER	33	Based on which Data Entry was pushed, act accordingly on the contents of the numerical entry register.
5	PANEL ON	43	Enable control panel C2. Light the lamp on C2.
5	PANEL OFF	44	Disable control panel C2. Light the lamp on C2.
5	VCO RESET	45	Send control data to A6 to short the VCO integrating capacitor.
6	ENTRY REQ'D	NA	Prompt operator that further entries are needed.
6	IN	NA	A6 locked on signal.
6	OUT	NA	A6 not locked on signal.
6	REMOTE	NA	A6 control at C2.
6	LOCAL	NA	A6 control at A6.
6 6	NORMAL OFFSET	NA NA	Indicates source of input to AN/WSC-3.

the signal must be converted to a usable frequency. This conversion is accomplished by the Primary Receiver local oscillator. Thus, in the "OFFSET" case, the received signal goes from antenna to RF group to down converter to up converter (receiver A6) to WSC-3. The properly converted signal can now be demodulated by the AN/WSC-3. Figure 23 shows a simplified block diagram of this system. Note that the WSC-3 OFFSET mode and normal operation of the Primary Receiver cannot occur simultaneously.

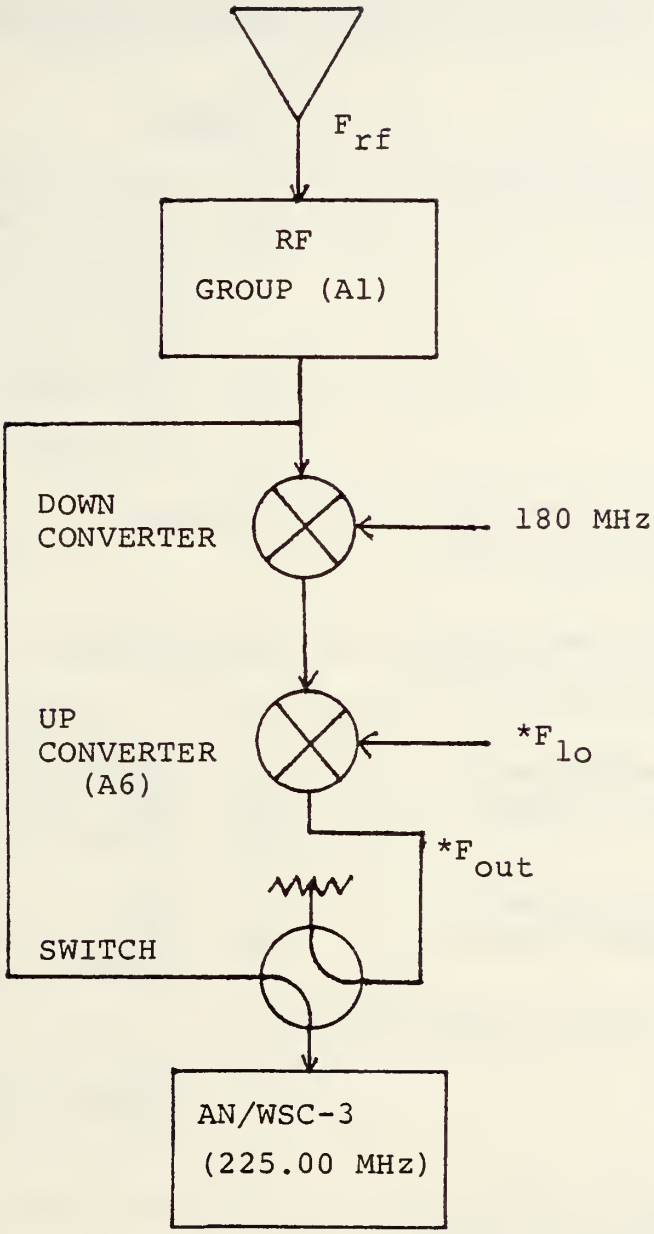
E. CONTROL PANEL TESTING

The Matrix Board generation of switch addresses, status, and interrupt signals was tested with satisfactory results. Future tests for proper operation should check the following: (1) Proper address (see Figure 21) for the depressed button is generated at IC3 and 4; (2) Status pulse is generated at IC16 pin 8 each time a button is pushed; (3) SATNO interrupt pulse is generated at IC16 pin 11 each time a button is pushed. Failure of any one of the above indicates improper operation of the Matrix Board and reference should be made to the troubleshooting guide in Table XII.

The Control Bus Test Panel (bottom of equipment rack 15) was used to test the Light Board. The test panel provided simulated computer data to the Light Board and all lighting tested satisfactory. Future tests using the Control Bus Test Panel should proceed as follows: (1) Strobe (up/down)

SCLRO; (2) Set in the address of the Light Board on data out switches; (3) Strobe ADRSO; (4) Set data out switches to 0100 0000; (5) Strobe CMD; (6) Use data out switches to set up lights (data out 0 corresponds to Light Board column 1) and DAO to clock the data to C2. In case of improper operation refer to troubleshooting guide Table XIII.

On completion of these tests, the project proceeded to step three, interfacing of equipment.



$F_{out} = F_{rf} - 180 + F_{lo}$

$F_{lo} = 405.00 - F_{rf}$ (IF WSC-3 SET AT 225 MHz)

Figure 23 - AN/WSC-3 OFFSET MODE

TABLE XII - MATRIX BOARD TROUBLESHOOTING

Symptom	Check
Address lines L-T not sweeping.	1. Button depressed. 2. Shorted switch or wiring. 3. Clock (IC14) stopped. 4. Check IC13p6. If clocking then problem limited to IC2, 3, 4. If not clocking check IC6, 7, 8, 9, 10, 11, 13. 5. +5 supply.
High order lines (R-T) not sweeping, but low order (L-P) OK.	IC1 and 3.
Low order lines (L-P) not sweeping, but high order (R-T) OK.	IC2 and 4.
No pulse generated at IC16p8 when button depressed.	1. IC9 and 16. 2. CMD 070 state must be low. 3. Address generating circuits.
No pulse generated at IC16p11 when button depressed.	1. IC8, 9, 12, 15, 16. 2. CMD 070 state must be low. 3. Address generating circuits.
Improper address being generated.	1. If high order error check IC1, 3, 5, 6. 2. If low order error check IC2, 4, 5, 6.
Depress button doesn't stop sweeping of address lines (L-T)	IC5, 6, 9, 10, 11, 13
No clock pulse.	1. Loss of +5v 2. IC14.

TABLE XIII - LIGHT BOARD TROUBLESHOOTING

Symptom	Check
Lamp test inoperative.	Loss of 28 v supply.
Any single light out.	Lamp test for bad bulb.
One or more of the following lights out:	
GAP, VC01-1.3, VC02-3, VC03-10, 0.2, PNLON, NORM.	IC1, 2, 3, 4, 12
A, VC01-1, VC02-10, VC03-30, 1, PNLOFF, SQUARE.	IC1, 2, 3, 5, 13.
B, VC03-100, 3, VCO RESET.	IC1, 2, 3, 6, 14.
C, VC01-10, VC02-100, VC03-300, 10, ENTRY REQ'D.	IC1, 2, 3, 7, 15.
AUX 1, 30.	IC1, 2, 3, 8, 16.
AUX 2.	IC1, 2, 3, 9, 17.
All lights on.	+28 v to drivers grounded.
All lights off.	1. IC1, 2, 3,. 2. Loss of +5 v.

IV. SYSTEM INTEGRATION

A. GENERAL

With the Primary Receiver (A6), Control Panel (C2), and the associated cabling and hardware interfacing complete, the next step was to develop the necessary software to cause these units to work together through the INTERDATA 7/32 Computer.

The main concern of this report was the creation of the Control Panel Operating Program. This program was developed in FORTRAN and is contained in Appendix A of this report. The individual driver programs for each piece of equipment (Primary Receiver, Control Panel, and Local Oscillator) were developed separately and will therefore not be covered in detail in this report.

B. CONTROL PANEL TO COMPUTER

The Control Panel to Computer interface is handled by the driver program, PANEL11, contained in reference 15. This driver performs two major functions. First, when a button on the control panel is pushed the driver reads the address generated by the Matrix Board. It then translates that address from its hexadecimal coded form (see Figure 21) to a decimal number to be used by the Control Panel Operating Program. Second, it performs the necessary logic to light the appropriate lamp on the control panel. The logic takes two forms: (1) if light X is on then light Y must be off,

and (2) only one light in rows A, B, and C can be on at any given time. These steps set and clear the appropriate bits in the lamp matrix (see Figure 22) and then the status of all lamps is updated simultaneously. A simplified block diagram of this is shown in Figure 24.

C. PRIMARY RECEIVER TO COMPUTER

The Primary Receiver to Computer interface is handled by the driver programs PRCVR11 and FLUKE11 contained in reference 14.

The receiver driver (PRCVR11) supplies control data to the receiver to determine selection of VCO and LFBW, IFBW, Normal or Squaring Loop, and VCO Reset. The control data pertaining to selection of these items is detailed in Table XIV. Note that DATA OUT bits 1, 3, 5, and 7 apply to the VCO and LFBW; bits 0, 2, and 4 apply to IFBW; bit 6 applies to Normal or Squaring Loop. Additionally, this driver provides status information to the computer about the receiver. It provides status on "IN" or "OUT" of lock and "LOCAL" or "REMOTE" operation for use by the Control Panel Operating Program.

The local oscillator driver (FLUKE11) provides control data to the receiver local oscillator (Fluke 6160B) to establish its frequency of operation.

A simplified block diagram of the Primary Receiver to Computer information flow is shown in Figure 25.

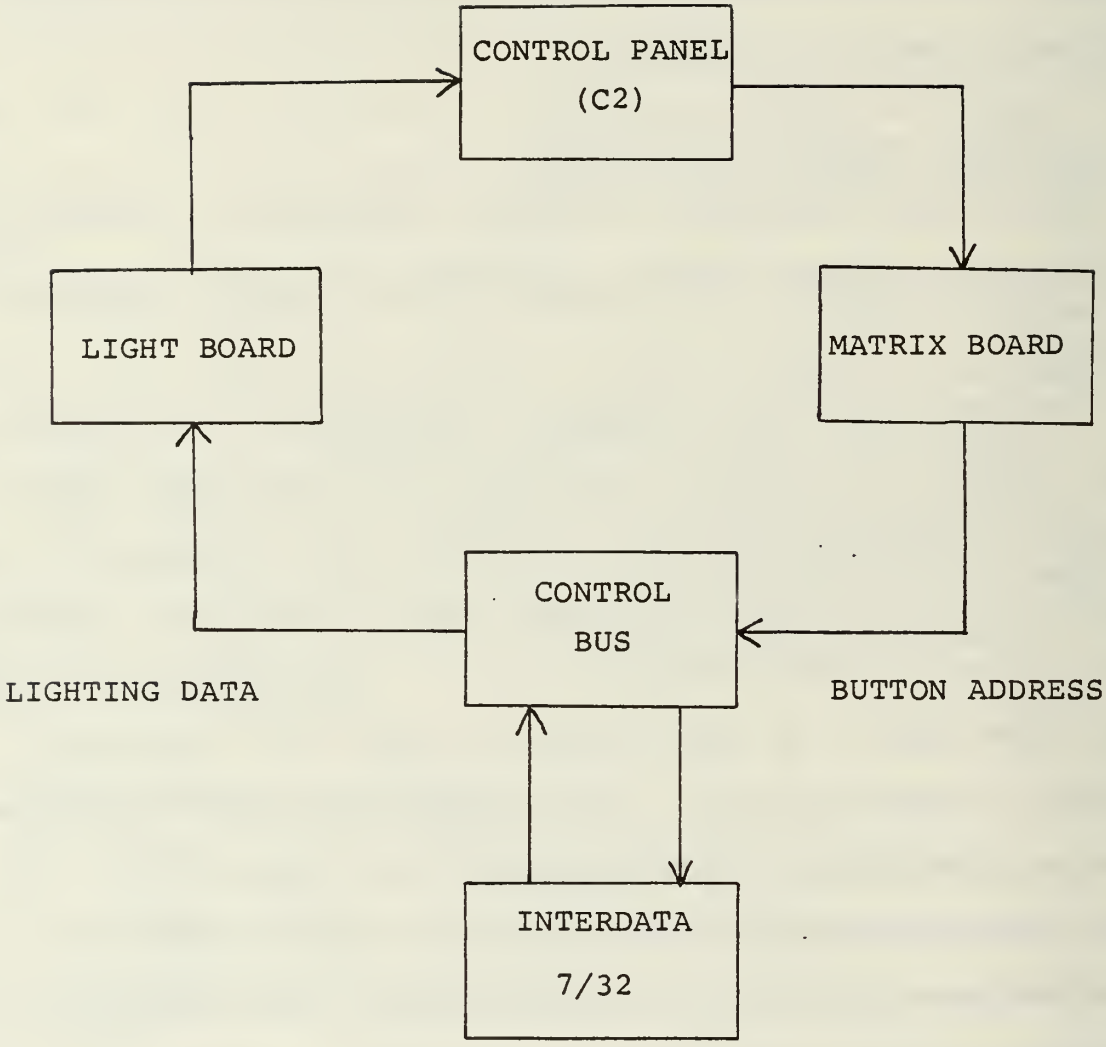


Figure 24 - Control Panel to Computer Information Flow

TABLE XIV - PRIMARY RECEIVER CONTROL DATA

VCO and LFBW

Select		Data Out Bits			
		010	030	050	070
VC01	.3	L	H	H	H
	1	L	H	H	L
	3	L	H	L	H
	10	L	H	L	L
VC02	3	H	L	H	H
	10	H	L	H	L
	30	H	L	L	H
	100	H	L	L	L
VC03	10	H	H	H	H
	30	H	H	H	L
	100	H	H	L	H
	300	H	H	L	L

TABLE XIV - PRIMARY RECEIVER CONTROL DATA (con't)

IF BANDWIDTH

Select	Data Out Bits		
	000	020	040
.2 KHz	H	L	H
1 KHZ	H	L	L
3 KHz	L	H	H
10 KHz	L	H	L
30 KHz	L	L	H

NORMAL/SQUARING LOOP

Select	Data Out Bit
	060
Normal	L
Squaring	H

VCO RESET

Pulse Command Line 070

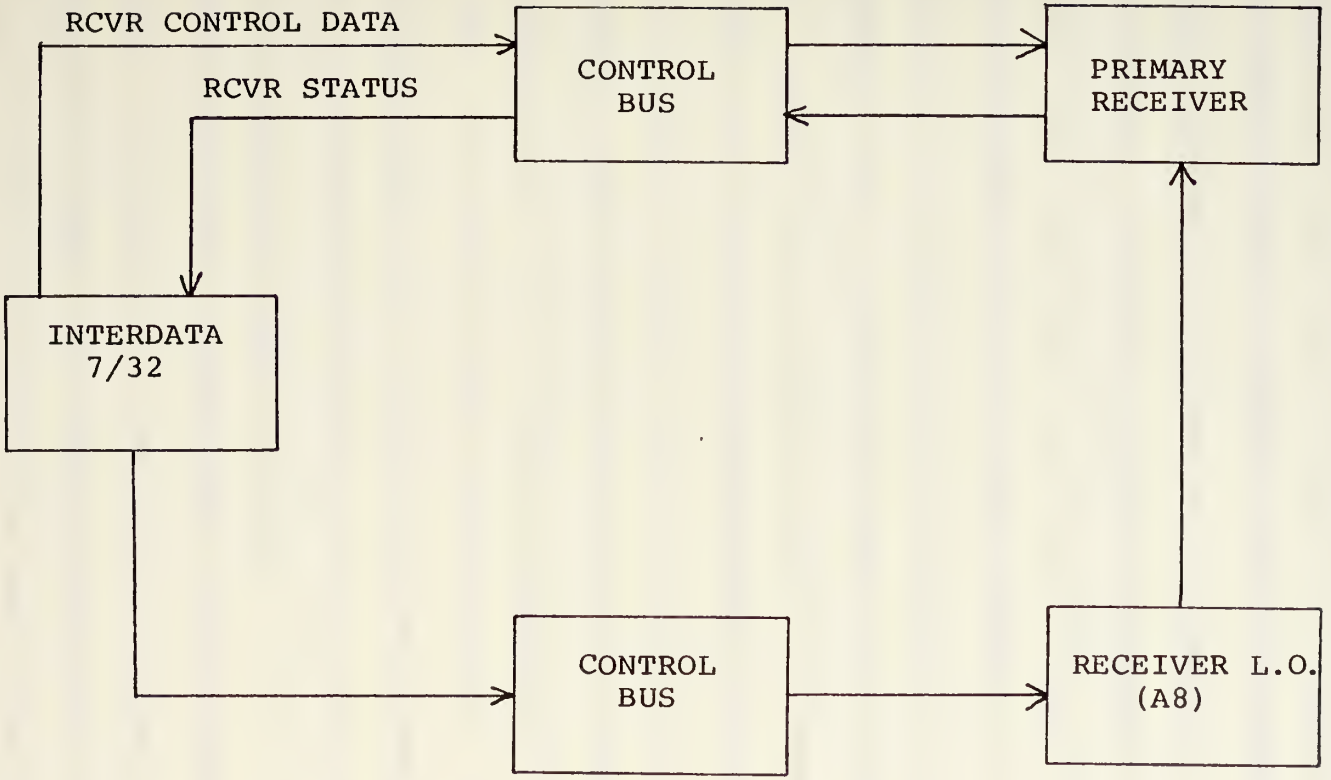


Figure 25 - Computer to Receiver Information Flow

D. CONTROL PANEL TO PRIMARY RECEIVER

The Control Panel to Receiver interface is handled by the Control Panel Operating Program (C20P) and the previously discussed equipment drivers (PANEL11, PRCVR11, and FLUKE11). This program was broken into two major sections. The first section was to provide a manual or "Mode 0" method of operation where the control panel duplicates the receiver front panel. The second section was to provide for multiple automatic modes of operation which preselect the receiver set-up, acquicition scheme, and method of data handling. These two sections were approached with the thought that an operable manual system could then be used to provide the pre-selected receiver set-up for the automatic modes. Thus, the basic program was created for the manual mode with provisions included for subsequent a-dition of the automatic modes as necessary.

The fundamental concept used in developing the program was that the control panel buttons could be categorized into the six groups listed in Table XI and a separate routine written to handle each of the groups. This idea is outlined in the simplified flow chart shown in Figure 26. Detailed flow charts for the entire program are shown in Figures 27-35. Each of the six main subsections as well as other aspects of the Control Panel Operating Program are discussed in detail below.

1. Program Initialization and Access

Initially there was only one means of accessing the C2OP program; that was by pushing a button on C2. With the acquisition scheme added, there will be a second means of access, the IN/OUT of lock status of the receiver. For either of these to access the program, the receiver must be in the REMOTE mode of operation. The control panel button means of access (NBUT) must first pass a test for valid entry, and is then used in a computed GO TO statement to trigger the appropriate routine. The second method, the IN/OUT of lock status of the receiver, is used to access the acquisition scheme. This will be covered in more detail in a later section.

When the program is initialized, all flags are cleared and all lights turned off with the exception of the PANEL OFF light. Thus, the control panel is initialized in the OFF or LOCKED-OUT condition. The only button which can be used initially is the PANEL ON button.

2. First Computer GO TO Statement

Once initialized and running, the program can be accessed by any control panel button which passes the valid entry tests (see Figure 26). This button entry (NBUT) is then processed by the computed GO TO statement which determines the routine applicable to that button.

3. Frequency Plan Routine

Entry of one of the frequency plan buttons specifies

a column in the data matrix known as IFREQ. This button, used in conjunction with a channel number entry, will select a unique frequency (see Tables IX and X) in the IFREQ matrix. In addition to selecting the matrix column, this routine also lights the appropriate control panel lamp. See Figure 27.

4. Receiver Action Button Routine

These buttons pertain to selection of VCO, LFBW, and NORM/SQ loop. On entry of one of these buttons this routine will cause the appropriate control bit stream (from data array IDOT) to be sent to the Primary Receiver to cause a configuration change. A receiver action button entry is only allowed when in the Manual or Mode 0 condition. This routine also lights the appropriate lamp on control panel C2. See Figure 28.

5. Data Entry Type Routine

An entry of this type (CHAN, CTR FREQ, MODE) is used to SET/CLEAR flags and clear counters in preparation for handling the subsequent numerical entry. This routine also lights the ENTRY REQ'D lamp to remind the operator that a numerical entry is required. See Figure 29.

6. Numerical Entry Routine

These entries are used in conjunction with the DATA ENTRY TYPE buttons to specify the actual data to be entered. The actual data is stored in NMBR. NMBR can be a channel number, a frequency in megahertz, or a mode designation. This routine is also used to clear or zero NMBR (clear entry)

and to increment the decimal point counter (N) if a decimal entry is made. Numerical entries are only valid when preceeded by a DATA ENTRY TYPE. Otherwise, they are ignored. There are no lights operated by this routine. See Figure 30.

7. Enter Routine

This routine is the heart of all data entries. The previously made entries to specify data type and numerical value can be thought of as "setting-up" for use of the ENTER button. This routine determines what type of data has been entered, exactly what the data value is, and what to do with the data. In the case of a channel or frequency entry the data is sent to the local oscillator driver. A mode entry is used to select the routine for the desired automatic mode by means of a computer GO TO. Additionally, if a channel or frequency entry is being made, and the system is in one of the automatic modes, this routine will be used to activate the appropriate acquisition scheme.

When in an automatic mode, entry of a channel number or frequency turns off the control panel when the routine has been completed. Since this is normally the last entry made at the control panel, this is done to prevent any subsequent accidental entries which might disrupt an operation in progress. More details on the automatic modes and acquisition are covered in a later section. The flow chart for this routine is shown in Figures 31, 32 and 33.

8. Option Button Routines

Each of the four option buttons has a separate routine. The PANEL ON routine merely turns off the PANEL OFF light and turns on the PANEL ON light. It also sets the PNLON flag. Likewise, the PANEL OFF routine clears the PNLON flag and handles the lights appropriately. The VCO RESET routine does two things. It sends a control data stream to the Primary Receiver to reset (zero) the VCO control voltage and it blinks the VCO RESET lamp on the control panel. The ENTRY REQ'D button is used as an indicator only. Pushing the button causes no noticeable action. The flowcharts for these routines are shown in Figure 34.

The routines detailed above completed the steps necessary to duplicate the receiver front panel operation at the control panel. Details concerning the automatic modes of operation and signal acquisition are covered in the following section.

E. AUTOMATIC MODES AND SIGNAL ACQUISITION

Selection of an automatic mode (a mode other than 0) causes the signal acquisition scheme to be brought into use also; therefore, these routines will be covered together.

1. As previously discussed in Section IV-D, the program allows for selection of various modes of operation. The term MODE, as used here, specifies a preset receiver operating set-up and a particular signal acquisition scheme. The number

of possible modes is unlimited; however, only three (modes 1, 2, and 33) have been included for demonstration purposes. See Table XV.

As shown in Figure 33, if Mode 1 or 2 (or any future value) is selected it is handled by a computed GO TO statement which initiates the appropriate routine. The preset routine will set the receiver steady-state VCO and LFBW, IFBW, Normal or Squaring Loop, and satellite frequency plan as well as lighting the appropriate lamps on the control panel. It also sets values for acquisition parameters pertaining to step-size (ISTEP), step-rate (IDLAY), and loop bandwidth. The operator must then enter the desired channel number or frequency at which time the acquisition routine will be initiated.

If Mode 33 is selected, the entry is handled by the Mode 33 routine. This routine turns off all control panel lamps associated with the Primary Receiver as it is no longer in use. The routine also sets a flag (Mode 33) in insure proper calculation of the local oscillator frequency for use with the AN/WSC-3.

It is anticipated that further automatic modes will be needed in the future. Their inclusion in the program requires only the following minor modifications: (1) Expand the "2ND Computer GO TO" to include the additional mode; and (2) Modify the test for illegal modes so that it will now allow the new mode. The routine for the new mode can now be inserted as a

TABLE XV - AUTOMATIC MODES

Mode No.	Functions
1	VCO - 1 S/S LFBW - 3 Hz ACQ. LFBW - 10 Hz IFBW - 3 kHz IDLAY - 2000 N/SQ - Squaring Freq. Plan - GAP ISTEP - 5 Hz
2	VCO - 2 S/S LFBW - 10 Hz ACQ. LFBW - 100 Hz IFBW - 1 kHz IDLAY - 3000 N/SQ - Squaring Freq. Plan - FLTSAT B ISTEP - 50 Hz
33	Set LO for AN/WSC-3 use Control Lights
99	Stop Program

NOTE:

S/S LFBW---Steady-state loop bandwidth
VCO--------Voltage controlled oscillator
ACQ. LFBW--Loop bandwidth during acquisition
IFBW-------Intermediate frequency bandwidth
N/SQ-------Normal or squaring loop operation
ISTEP------LO step size during acquisition
IDLAY------Delay(MSEC) between steps during acquisition

block following the previously last automatic mode routine.

Future probable additional functions of the automatic mode will be to preset the data taking or count interval and local oscillator step rate when in acquisition. The automatic mode routine can also be used to select whether to plot data, store data, or both.

2. Signal Acquisition Routine

The purpose of this routine is to cause the receiver to search for a signal whenever one of the following conditions occurs: (1) A new channel number is selected; (2) A new center frequency is selected; (3) A previously "LOCKED-ON" signal is lost. This search is accomplished by first setting the receiver to a wider LFBW and then stepping the local oscillator through a given range around the selected frequency. Throughout the search, periodic sampling of the receiver IN/OUT status (ISTAT) is done to note when acquisition occurs.

If the search is completed without acquisition, the routine will cause the 'ENTRY REQD' light to blink five times, thereby notifying the operator. During the acquisition routine, the local oscillator will be stepped through the given range of searched frequencies ten times or until stopped either by locking on a signal or by operator interaction. The operator may cancel this search and end acquisition at anytime by making any button entry at the control panel. At this time, acquisition will not be restarted except through

the normal sequence of entries (i.e. a new channel number or center frequency is entered). If acquisition does occur, this routine will then cause the receiver to return to the desired steady-state LFBW for the selected mode.

A flowchart for the acquisition routine is shown in Figure 35. The step size (ISTEP) and step rate (IDLAY) used in the program were chosen for test purposes only and can be adjusted to suit operational conditions as necessary. The currently selected step size is 5 Hz for Mode 1 and 50 Hz for Mode 2. In the program these step sizes are specified in tenths of Hertz as are all of the local oscillator frequencies. The step rate (delay time between steps) currently in use is 2 seconds for Mode 1 and 3 seconds for Mode 2.

The search routine first increases the local oscillator frequency by going through 5 step-up and delay increments, then decreases the frequency by going through 10 step-down and delay increments, and then back up by 5 again returning to the original frequency. Thus, one search cycle requires 40-60 seconds. In operational use, search times will be much shorter.

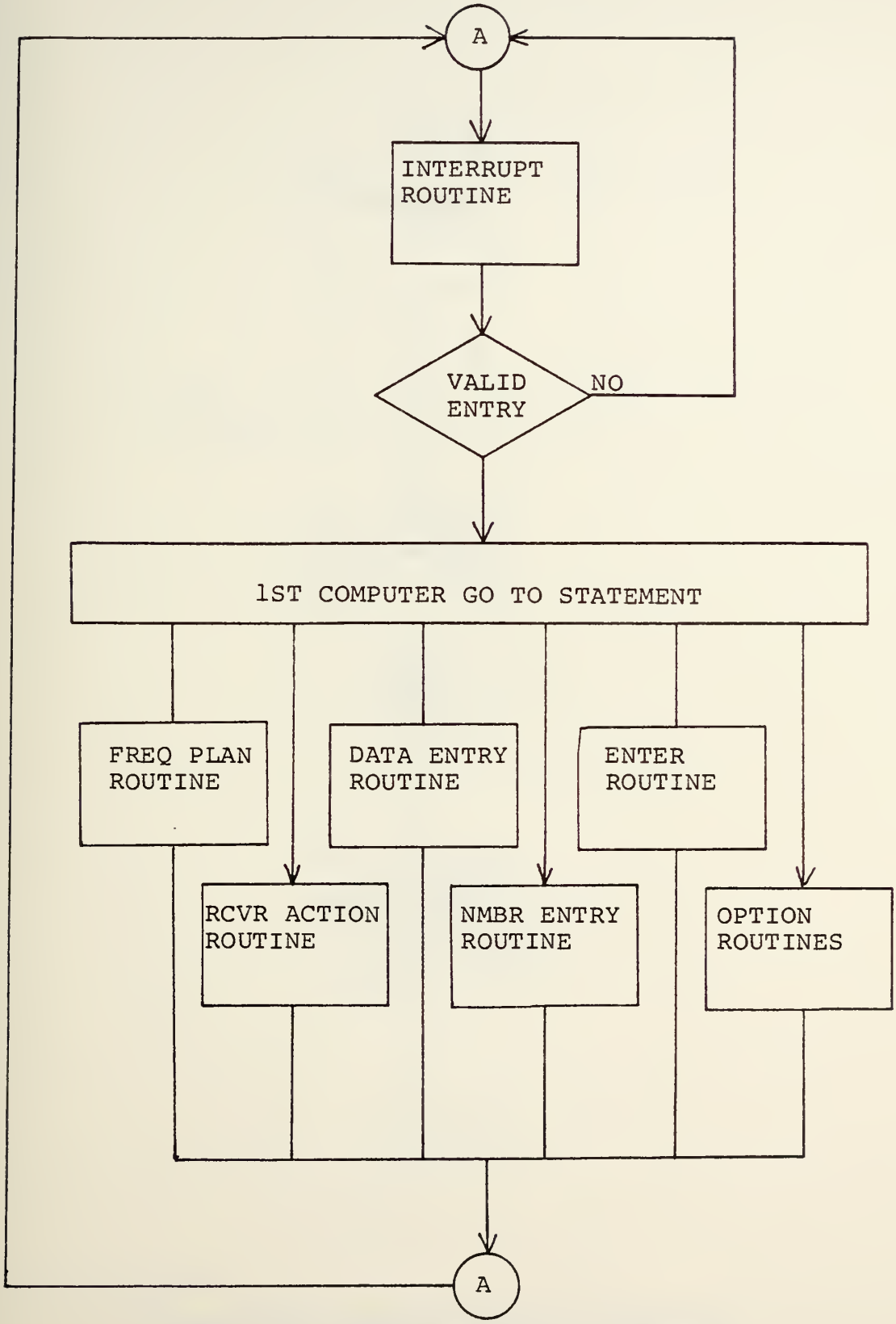


Figure 26 - C2 Operating Program Flowchart

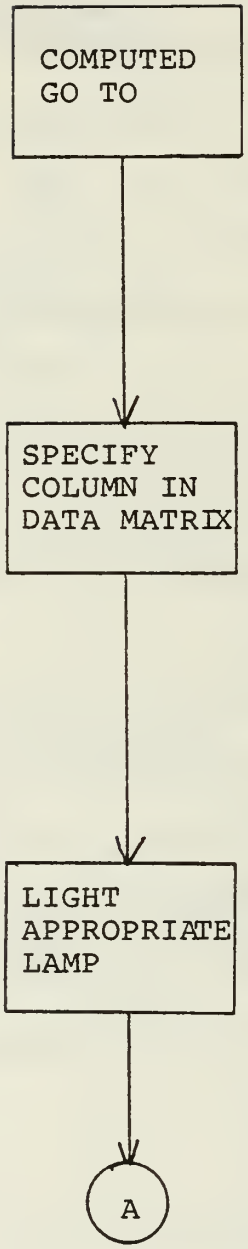


Figure 27 - Frequency Plan Routine

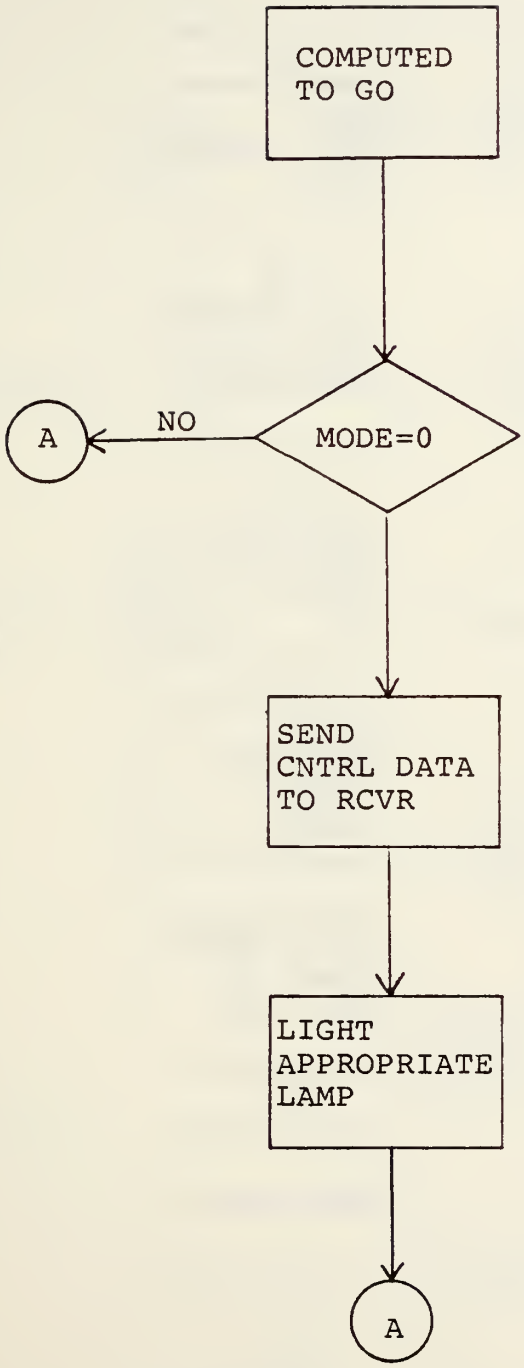


Figure 28 - Receiver Action Routine

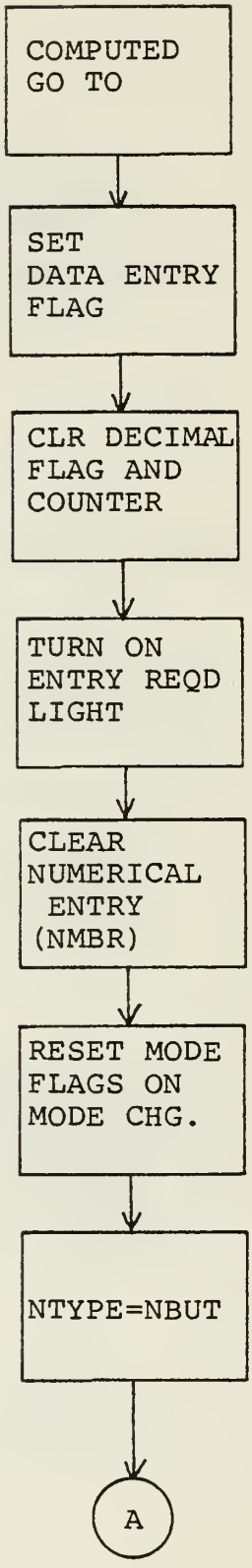


Figure 29 - Data Entry Routine

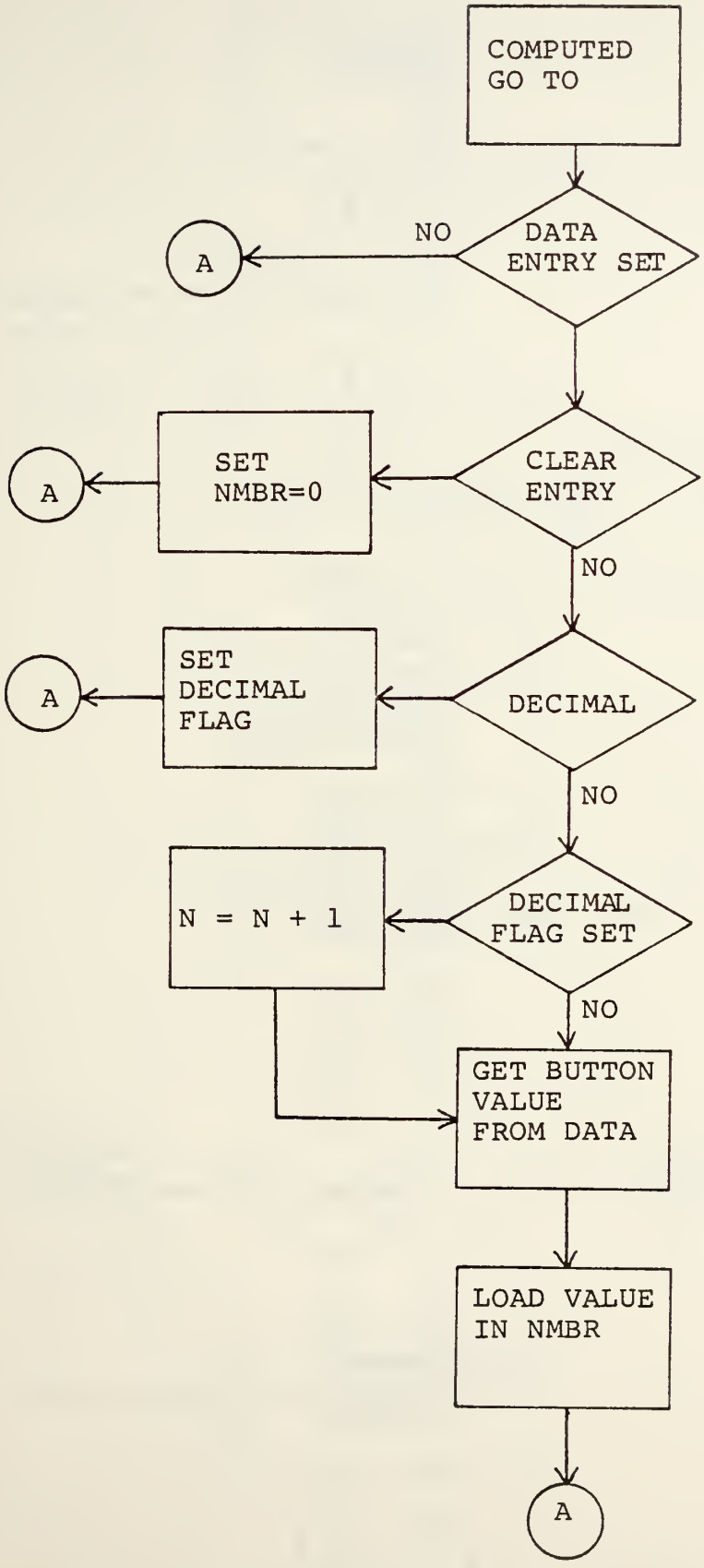


Figure 30 - Number Entry Routine

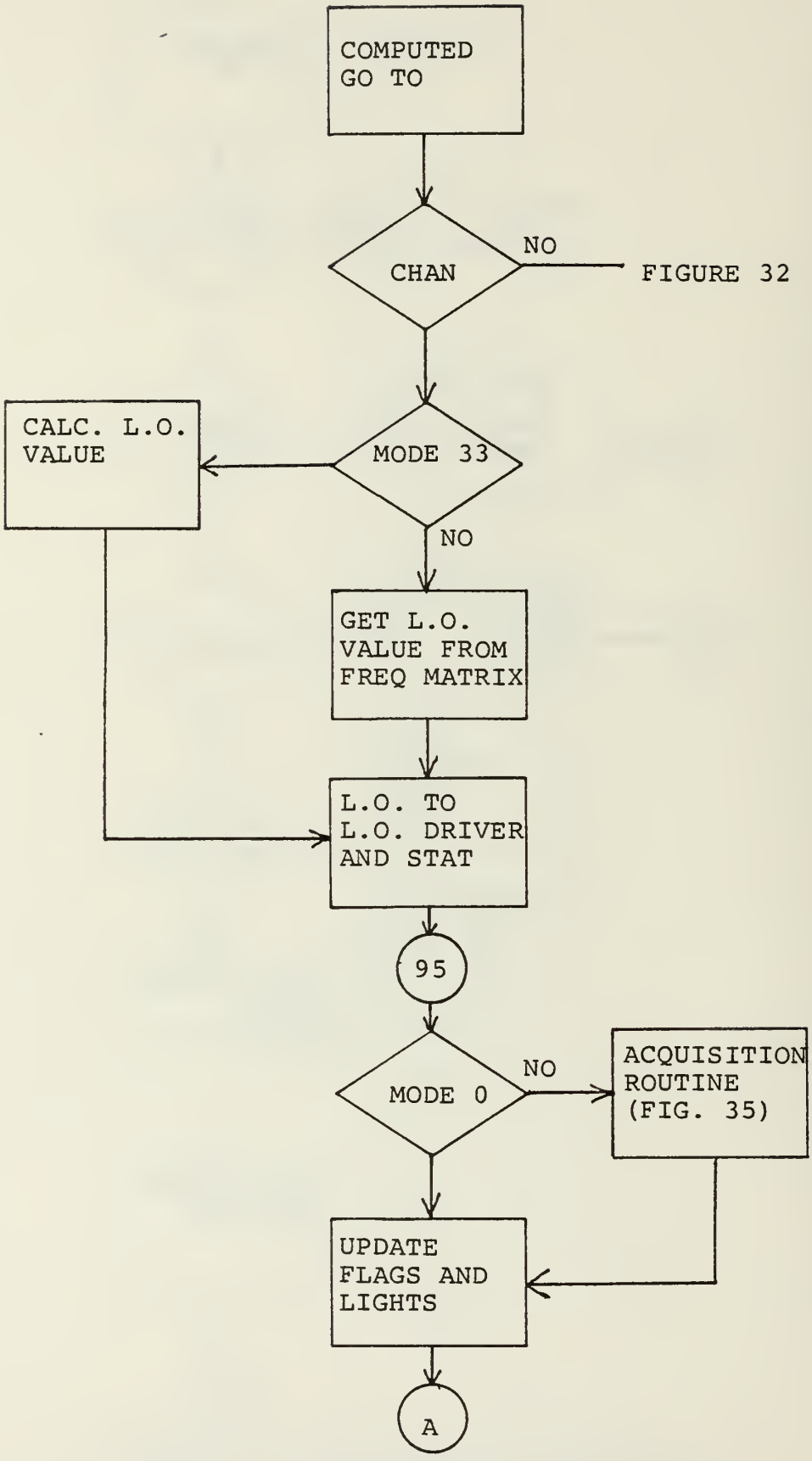


Figure 31 - Enter Button Routine (CHAN)

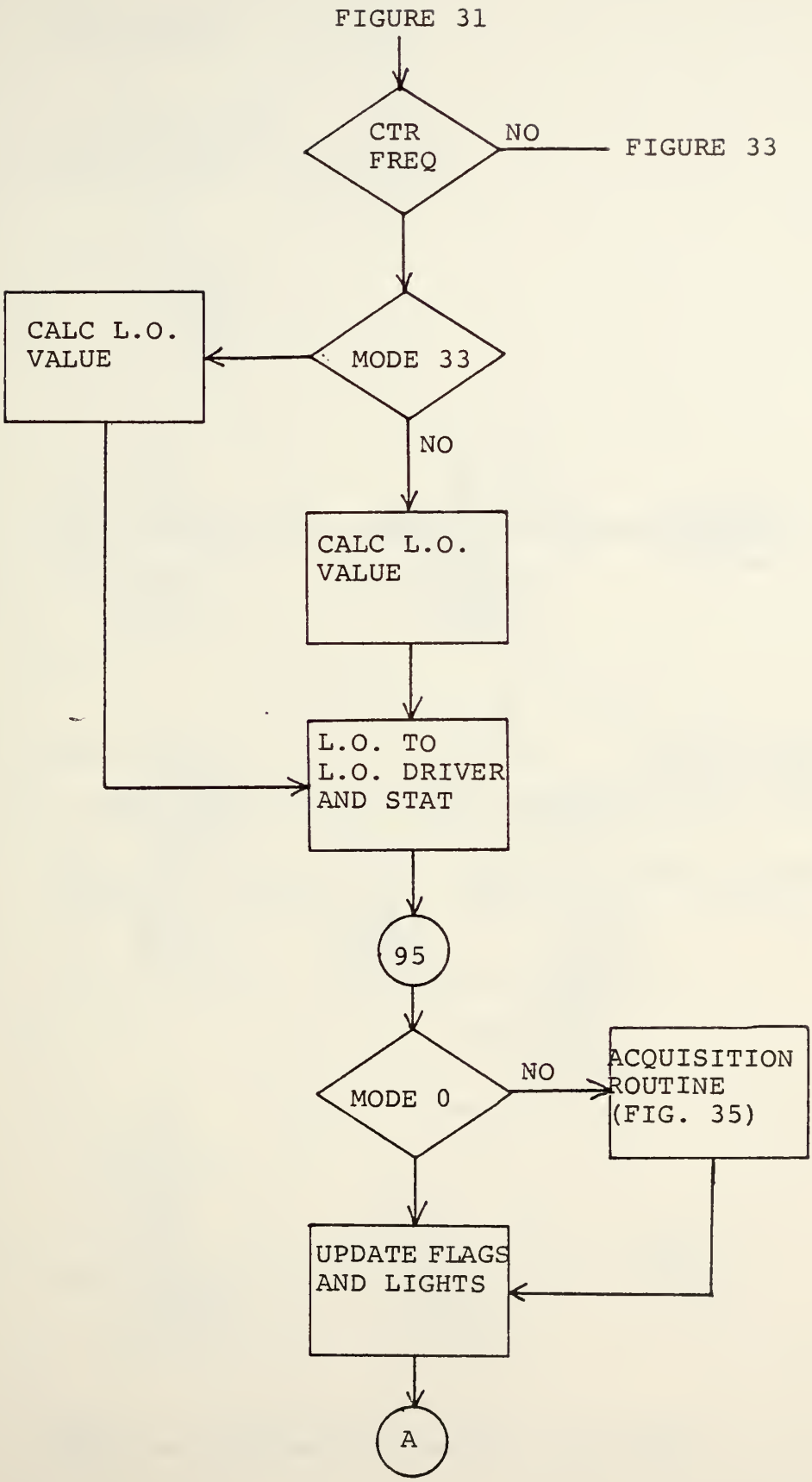


Figure 32 - Enter Button Routine (CTR FREQ)

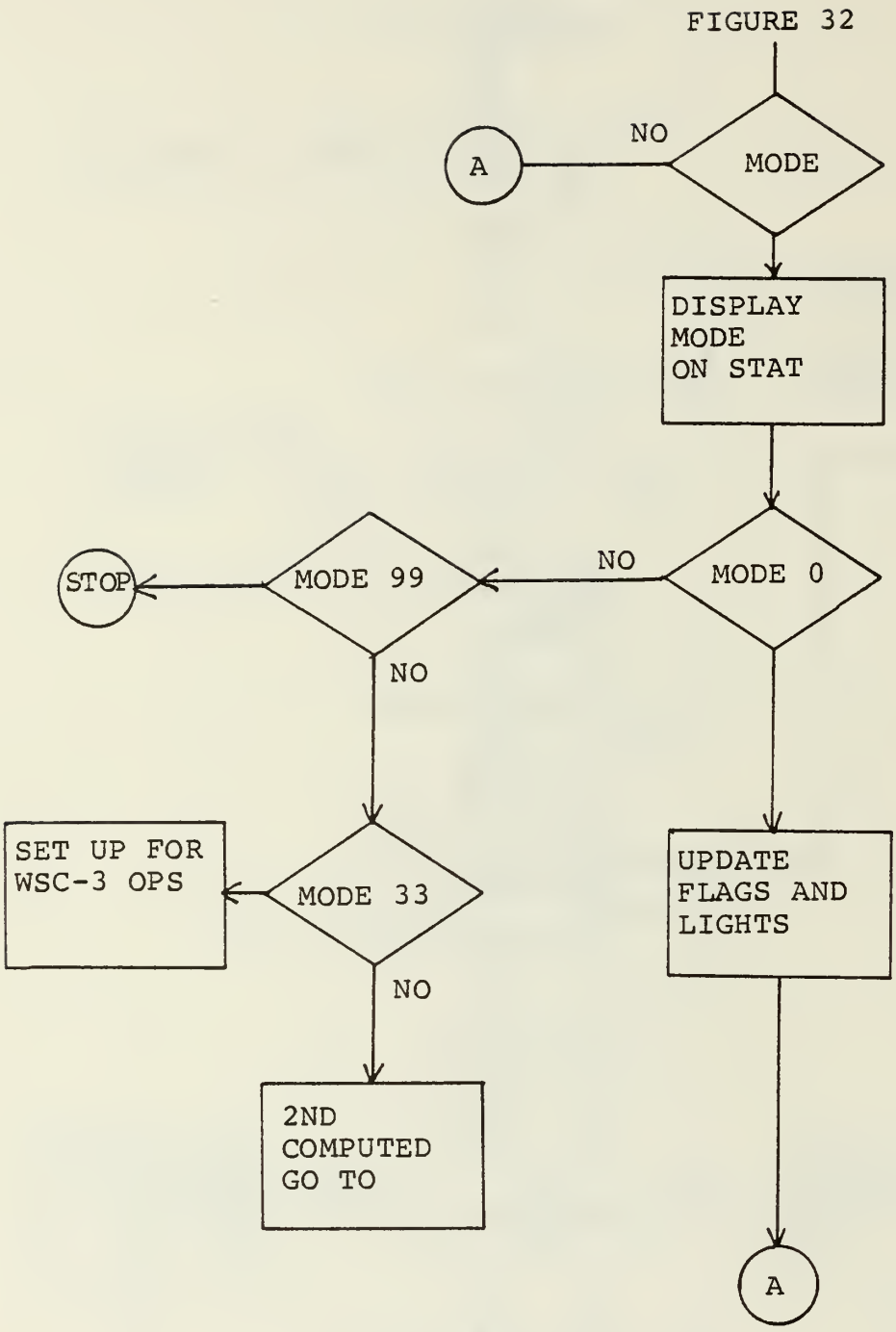


Figure 33 - Enter Button Routine (MODE)

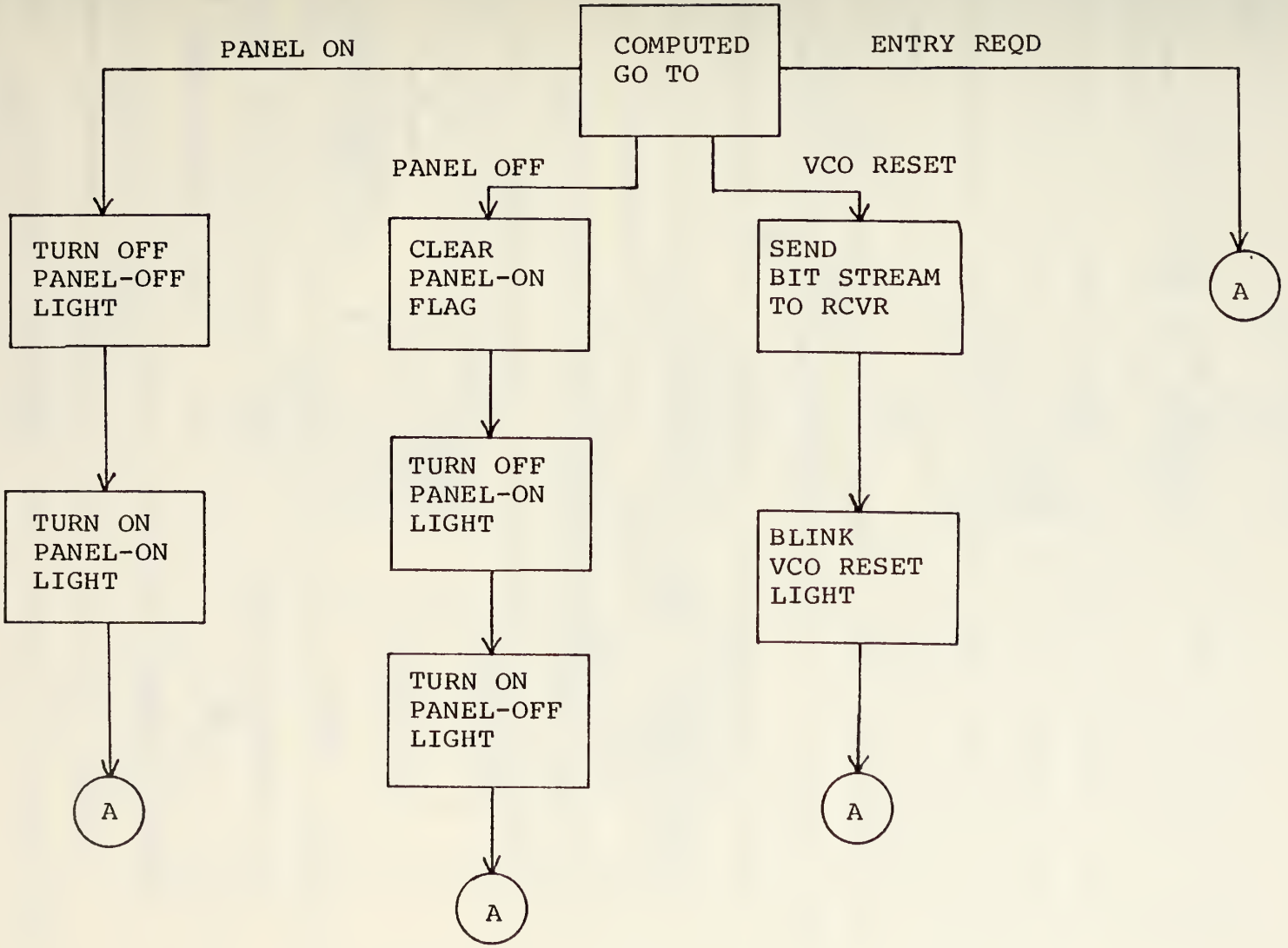


Figure 34 - Option Button Routines

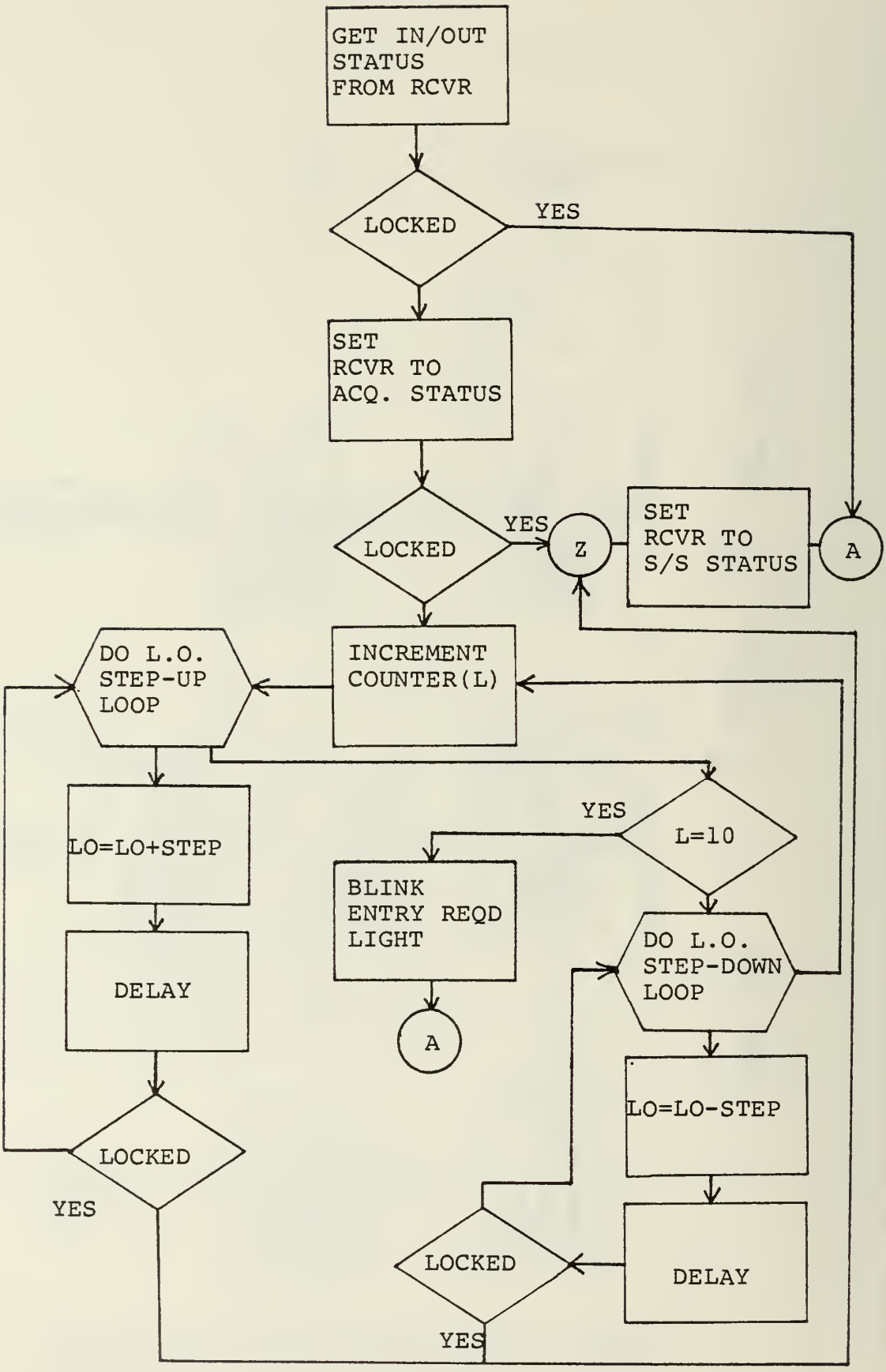


Figure 35 - Acquisition Routine

V. DATA

A. GENERAL

In the future, the C20P program will also include a data taking capability. That is, the ability to read the HP frequency counter (A7) and transfer this data to either a display or storage device. Presently, when the program has completed handling an interrupt from either the receiver or control panel, it goes into a "wait" (Call KTLWAT) or dormant state until the next interrupt occurs. When data taking is added to the program, instead of returning to a dormant condition on completion of handling an interrupt, the program will go into a data taking loop. On sebsequent interrupts, it will discontinue data taking, handle the interrupt, and return to data taking. The statements needed to accomplish this sort of loop are already included in the C20P program as comments (Call A6DATA and GO to 6).

B. DATA PROGRAMS

Appendix B of this report contains a copy of a subroutine (A6DATA), currently being tested to handle the data taking capability of the program, and a copy of the stand alone program from which it was condensed (A6DAT). The called subroutines and the HP 9830A DATA LINK program are also included in Appendix B. The DATA LINK program and subroutines HPCMD and HPDATA are covered in reference 14.

The A6DATA subroutine requires interfacing the INTERDATA

7/32 computer with a Hewlett Packard model 9830A calculator. Timing problems were experienced in attempting to get these equipments to operate together. These timing problems, at present, preclude the possibility of adding the data taking feature to C20P. The HP 9830A is presently used to manage the IEEE 488 data bus through which the frequency counter provides its data. A modification to the INTERDATA 7/32, to be made in the near future, will allow it direct control of the IEEE 488 bus and eliminate the need for the HP calculator. Therefore, further efforts toward eliminating the current timing problems are considered inappropriate. However, when the appropriate subroutine is developed, it may be added to C20P by merely deleting the Call KTLWAT statement and adding the Call A6DATA and GO TO 6 statements.

Figure 35 shows a flowchart for the subroutine A6DATA.

Figure 35 - Data Taking Subroutine

VI. CONCLUSION

The necessary circuit modifications and additions to the Primary Receiver have been installed and tested and the receiver is operating as designed. The Primary Receiver Control Panel installation has been completed and a computer program developed to allow receiver operation from this control panel. The control panel operating program has been tested, debugged, and operationally demonstrated.

With the exception of the data taking capability, the integration of the Primary Receiver into the NAVPGSCOL SATCOM Signal Analyzer is complete.

APPENDIX A - C2 OPERATING PROGRAM(C20P)

```
C      ********** C2 OPERATING PROGRAM **********
C
C       THIS PROGRAM INTERFACES THE C2 CONTROL PANEL WITH
C       THE A6 RECEIVER AND ITS L.O.
C
C
       ADDRESS INTRPT
       LOGICAL PNLON,DATENT,MODE0,DPT,MODE33
       DIMENSION IDOT(32),NVAL(31),IFREQ(24,4)
       DATA IDOT/X'240',X'241',X'244',X'245',7*X'000',X'210',
      C X'211',X'214',X'215',X'300',X'302',4*X'000',X'200',
      C X'201',X'204',X'205',X'120',X'123',X'180',X'188',
      C X'1A0',X'4C6',X'433'/
       DATA NVAL/9*0,7,8,9,22,4*0,4,5,6,23,1,2,3,7*0/
       DATA IFREQ /988250000,988500000,988750000,989000000,
      C989250000,989500000,989750000,990000000,990250000,
      C990500000,990750000,991000000,991250000,991500000,
      C991750000,992000000,992250000,992500000,992750000,
      C993000000,993250000,993500000,1041500000,1075500000,
      C0,1004500000,1019500000,1036500000,1053500000,
      C1069500000,1084500000,1153500000,1168500000,1182500000,
      C1197500000,939450000,939550000,939600000,939650000,
      C939700000,939750000,939800000,939850000,939900000,
      C939950000,940000000,940100000,1106000000,0,
      C1005500000,1020500000,1037500000,1054500000,1070500000,
      C1085500000,1154500000,1169500000,1183500000,1198500000,
      C940450000,940550000,940600000,940650000,940700000,
      C940750000,940800000,940850000,940900000,940950000,
      C941000000,941100000,1117000000,0,
      C1006500000,1021500000,1038500000,1055500000,
      C1071500000,1086500000,1155500000,1170500000,1184500000,
      C1199500000,941450000,941550000,941600000,941650000,
      C941700000,941750000,941800000,941850000,941900000,
      C941950000,942000000,942100000,1123000000/
C
C
C        ESTABLISH INITIAL CONDITIONS AND BRING PANEL UP
C        IN THE 'PANEL OFF' STATE.
C
       INTRPT=A'1100'
C      CALL CNTSET
C       DEFAULTS ARE:
        JFREQ=1
        PNLON=.FALSE.
        DATENT=.FALSE.
        MODE0=.TRUE.
        DPT=.FALSE.
        NTYPE=0
        MODE33=.FALSE.
C
C
        DO 5 I=1,47
```

```
          CALL KTLWR(2,-1)
    5     CONTINUE
       CALL KTLWR(2,45)
       CALL KTLON(2,INTRPT)
       CALL KTLWAT
C
C      WHEN DATA TAKING IS ADDED TO THIS PROGRAM, THE
C      FOLLOWING TWO STATEMENTS WILL PUT THE PROGRAM
C      IN A LOOP TO TAKE DATA AND UPDATE THE STATUS
C      DISPLAY WHILE WAITING FOR AN INTERROPT
C
C    6 CALL A6DATA
C      GO TO 6
C
C                 INTERRUPT ROUTINE
C
 1100 CALL KTLRD(IUNIT,IVALUE)
      IF(IUNIT.EQ.2) GO TO 15
      IF(IUNIT.EQ.6) GO TO 400
      CALL KTLRET
C
C
C          GET A BUTTON # / CHECK VALID ENTRY / GO TO ROUTINE
C
C
   15 CALL KTLOFF (6,INTRPT)
      NBUT=IVALUE
       IF(NBUT.EQ.44)PNLON=.TRUE.
       IF(.NOT.PNLON)GO TO 10
       IF(NBUT.GT.47.OR.NBUT.LT.1)GO TO 10
C
C           1ST COMPUTED GO TO
C
      GO TO (20,30,40,50,10,10,60,60,60,70,70,70,70,80,80,80,
     C80,70,70,70,70,70,70,70,80,80,80,80,80,80,70,70,70,
     C90,80,80,80,80,80,80,80,80,80,100,110,115,10),NBUT
C
C
C         ROUTINE FOR FREQ PLAN BUTTONS
C
C
  20  JFREQ=1
      GO TO 200
  30  JFREQ=2
      GO TO 200
  40  JFREQ=3
      GO TO 200
  50  JFREQ=4
      GO TO 200
C
C
C         ROUTINE FOR DATA ENTRY BUTTONS
```

```
C
C
   60  DATENT=.TRUE.
       DPT=.FALSE.
       N=0
       CALL KTLWR(2,47)
       NMBR=0
       NTYPE=NBUT
       IF(NTYPE.NE.9)GO TO 10
       MODE0=.FALSE.
       MODE33=.FALSE.
       GO TO 10
C
C
C          ROUTINE FOR NUMBER ENTRY BUTTONS
C
C
   70  IF(.NOT.DATENT)GO TO 10
       IF(NBUT.EQ.33)GO TO 73
       IF(NBUT.EQ.32)GO TO 72
       IF(DPT) N=N+1
       IVAL=NVAL(NBUT)
       NMBR=NMBR*10+IVAL
       GO TO 10
   72  DPT=.TRUE.
       GO TO 10
   73  NMBR=0
       GO TO 10
C
C
C           ROUTINE FOR RCVR ACTION BUTTONS
C
C
   80  IF(.NOT.MODE0)GO TO 10
       CALL KTLWR(6,IDOT(NBUT-13))
       GO TO 200
C
C
C             ROUTINE FOR 'ENTER' BUTTON
C
C
C
C    WHICH DATA ENTRY BUTTON PUSHED
C
    90 IF(NTYPE.EQ.7)GO TO 94
       IF(NTYPE.EQ.8)GO TO 96
       IF(NTYPE.NE.9)GO TO 10
       MODE=NMBR
       IF(MODE.LT.0.OR.MODE.GT.99)GO TO 10
       IP1=Y'0F000030'
       IP2=Y'43000000'
       IP3=Y'40000000'
```

```
      WRITE(3,900)IP1,IP2,IP3,MODE
 900  FORMAT(3A1,'MODE=',I2)
C
C  SELECT THE MODE
C
      IF(MODE.EQ.0)GO TO 91
      IF(MODE.NE.99)GO TO 120
      CALL KTLOFF(2,JUNK)
      CALL KTLOFF(6,JUNK)
      STOP
  91  MODE0=.TRUE.
      GO TO 97
C
C
C   SELECT THE CHANNEL NUMBER
C
C
  94  IF(NMBR.GT.23)GO TO 10
      IF(NMBR.LT.0)GO TO 10
      IF(MODE33) LO=(405000000-IFREQ(NMBR+1,JFREQ)/10-15000000
      IF(.NOT.MODE33) LO= IFREQ(NMBR+1,JFREQ)
      CALL KTLWR(8,LO)
      IF(MODE33)LNKDN=405000000-LO/10
      IF(.NOT.MODE33)LNKDN=150000000+LO/10
      LNK1ST=LNKDN/10**6
      LNK2ND=LNKDN-LNK1ST*1000000
      IP1=Y'0F000000'
      IP2=Y'43000000'
      IP3=Y'48000000'
      WRITE(3,940)IP1,IP2,IP3,NMBR,LNK1ST,LNK2ND
 940  FORMAT(3A1,'CHAN=',I2,' CFREQ=',I3,'.',I6)
  95  IF(MODE0)GO TO 97
      IF (MODE33) GO TO 951
C
C
C ****************** ACQR ******************************
C   THIS ROUTINE IS TO CAUSE THE A6 RCVR TO GO INTO AN
C   ACQUISITION LOOP WHENEVER CHAN/FREQ CHANGES ARE
C   MADE OR THE SYSTEM DROPS OUT OF LOCK.
C
C
C    NOTE:  KTLST(6,JUNK) HAS THE FOLLOWING VALUES
C               -1 ---- LOCAL/UNLOCKED
C               4 ---- REMOTE/UNLOCKED
C               -1 ---- LOCAL/LOCKED
C               0 ---- REMOTE/LOCKED
C    -1 INDICATES A6 NOT AVAIL. FOR AUTO MODES
C
C
C     BEGIN ACQ. SCHEME BY GOING TO APPROPRIATE ACQ. SW
C
$TRCE
```

```
            IF (ISTAT.EQ.0) GO TO 565
  610       CONTINUE
        IF (M.EQ.1) GO TO 625
        M=1
        DO 620 K=1,10
            CALL KTLWR (6,0)
            CALL WAITMS(IDLAY)
            ISTAT=KTLST(6,JUNK)
            LO=LO-ISTEP
            CALL KTLPND(IDUMY,INTPND)
            IF(INTPND.EQ.1)GO TO 97
            CALL KTLWR (8,LO)
            IF (ISTAT.EQ.0) GO TO 565
  620       CONTINUE
        GO TO 601
C
C            BLINK THE 'ENTRY REQD' LIGHT TO INDICATE
C            SEARCH COMPLETE BUT NO SIGNAL FOUND.
C
  625 DO 670 K=1,5
            CALL KTLWR (2,47)
$NTRE
            CALL WAITMS(200)
            CALL KTLWR (2,-47)
            CALL WAITMS(200)
  670       CONTINUE
            IF(L.LT.10)GO TO 600
C ***************** END ACQR ***************************
  951 PNLON=.FALSE.
        CALL KTLWR(2,-44)
        CALL KTLWR(2,45)
        GO TO 97
C
C    SELECT THE CTR FREQ
C
C
C         THERE IS SOME ARITH. IN THIS ROUTINE TO
C         PREVENT OVERFLOW DUE TO LARGE VALUES
C
   96 IF(N.LT.0.OR.N.GT.6)GO TO 10
      NEXP=6-N
      IF(NEXP.EQ.0)GO TO 962
      DO 961 I=1,NEXP
           NMBR=NMBR*10
  961       CONTINUE
  962 IF(MODE33) LO=(405000000-NMBR)*10
      IF(.NOT.MODE33) LO=(NMBR-150000000)*10
      CALL KTLWR(8,LO)
      LNK1ST=NMBR/10**6
      LNK2ND=NMBR-LNK1ST*1000000
      IP1=Y'0F000000'
      IP2=Y'43000000'
```

```
      IP3=Y'48000000'
      WRITE(3,960)IP1,IP2,IP3,LNK1ST,LNK2ND
 960  FORMAT(3A1,'CHAN=NA CFREQ=',I3,'.',I6)
      GO TO 95
  97  CALL KTLWR(2,-47)
  98  NTYPE=0
      DATENT=.FALSE.
      GO TO 10
C
C           ROUTINE FOR PANEL ON
C
 100  CALL KTLWR(2,-45)
      GO TO 200
C
C           ROUTINE FOR PANEL OFF
C
 110  PNLON=.FALSE.
      CALL KTLWR(2,-44)
      CALL KTLWR(2,45)
      IF (.NOT.MODE0) CALL KTLON (6,INTRPT)
      GO TO 10
C
C     VCO RESET ROUTINE
C
  115 CALL KTLWR(6,0)
      CALL KTLWR(2,46)
      CALL WAITMS(200)
       CALL KTLWR(2,-46)
       GO TO 10
C
C      ROUTINES FOR MODES OTHER THAN 0
C
 120  IF(MODE.EQ.33)GO TO 333
      IF(MODE.GT.2)GO TO 10
C
C          2ND COMPUTED GO TO
C
      GO TO (130,140),MODE
C
C **** MODE 1 ********* VCO1-3 *** IFBW-3 *** SQ ***
C
  130 JFREQ=1
      CALL KTLWR(6,IDOT(31))
      CALL KTLWR(2,1)
      CALL KTLWR(2,16)
      CALL KTLWR(2,41)
      CALL KTLWR(2,30)
      ISTEP = 50
      IDLAY = 2000
      GO TO 98
C
C **** MODE 2 ********* VCO2-10 *** IFBW-1 *** SQ ***
```

```
C
  140 JFREQ=3
      CALL KTLWR(6,IDOT(32))
      CALL KTLWR(2,3)
      CALL KTLWR(2,26)
      CALL KTLWR(2,40)
      CALL KTLWR(2,30)
      ISTEP = 500
      IDLAY = 3000
      GO TO 98
C
C ************ ADD NEW AUTO MODES HERE ************
C
C             LIGHT A LAMP (NBUT)
C
 200  CALL KTLWR(2,NBUT)
       GO TO 10
C
C           MODE33 --- WSC 3 OFFSET MODE
C
  333 DO 335 I=14,43
            CALL KTLWR(2,-I)
  335       CONTINUE
      MODE33=.TRUE.
      GO TO 98
  10  CALL KTLEN(2,INTRPT)
      CALL KTLRET
      END
```

```
KTL       PROG  CONTROL BUS I/O (FORTRAN-CALLABLE) - CC 5-16-7
*                                    REVISION 1
*
R0        EQU   0
R1        EQU   1
R2        EQU   2
R3        EQU   3
R4        EQU   4
R5        EQU   5
R6        EQU   6
R7        EQU   7
R8        EQU   8
RB        EQU   11
SP        EQU   11
RC        EQU   12
RE        EQU   14
RF        EQU   15
*
*  STACK EQUATES:
STACK     STRUC
SAVE      DS    64                  REGISTER SAVE AREA
FCN       DS    1                   SVC11 PARAMETER BLOCK
PUN       DS    1
STATUS    DS    1
DEVADD    DS    1
DATA      DS    4
SIXBLK    DS    8                   SVC6 PARAMETER BLOCK
SIXFCN    DS    4
          DS    2
SIXSTAT   DS    2
          DS    12
DEVMNEM   DS    4
          DS    16
          ENDS
*
UDL.TSKQ  EQU   16                  ADDRESS OF TASK QUEUE
UDL.TSKO  EQU   112                 TQSI OLD TSW SAVE LOC.
UDL.TSKN  EQU   120                 TQSI NEW TSW LOC.
*
*
          ENTRY KTLPUN,KTLWR,KTLST,KTLPND
          ENTRY KTLON,KTLOFF,KTLWAT
          ENTRY KTLEN,KTLSIM
          ENTRY KTLRD,KTLRET
*
*
          TITLE SUBROUTINE ENTRY AND EXIT PROCEDURES
*
ENTER     EQU   *                   LOCAL SUBROUTINE
*
          SHI   RC,STACK            BUMP R12 STACK POINTER
          STM   R0,SAVE(RC)         SAVE CALLER'S REGISTERS
```

```
         LR    SP,RC              STACK POINTER TO R11
ENTER2   LIS   R0,6
         CH    R0,0(RF)           LOOK AT NO. OF PARAMETERS
         BNZ   0                  IF 2*(N+1) NOT = 6, CRASH
*
*              THERE MAY OR MAY NOT BE A HALFWORD FILLER
*              FOLLOWING THE NO.-OF-PARAMETERS HALFWORD:
         NHI   RF,X'FFFC'         MASK TO NEXT LOWER FULLWD
         L     R6,4(RF)           R6 HAS 1ST ADDRESS PASSED
         L     R4,0(R6)           R4 HAS UNIT NUMBER
         L     R7,8(RF)           R7 HAS 2ND ADDRESS PASSED
         L     R5,0(R7)           R5 HAS VALUE
         BR    RE                 RETURN TO MAIN ROUTINE
*
*
*
EXIT     EQU   *                  LOCAL SUBROUTINE
*
         ST    R0,4*RE(SP)        STATUS --> CALLER'S R14
         LM    R0,SAVE(SP)        LOAD CALLER'S REGISTERS
         AHI   RC,STACK           POP STACK POINTER
EXIT2    AIS   RF,12              BUMP RETURN ADDRESS
         NHI   RF,X'FFFC'         MASK TO NEXT LOWER FULLWD
         BR    RF                 RETURN TO CALLER OF KTL...
*
*
*
         TITLE MAIN KTL ROUTINES, NON-INTERRUPT
*
KTLPUN   EQU   *
*
         BAL   RE,ENTER
         LIS   R0,0               PUN FCN
         BAL   R8,SVC11           DO THE SVC11
         LB    R1,DEVADD(SP)      LOAD THE RETURNED NO.
         ST    R1,0(R6)           RETURN IT AS UNIT NO.
         B     EXIT               RETURN TO CALLER
*
*
KTLWR    EQU   *
*
         BAL   RE,ENTER
         LIS   R0,1               WRITE FCN
         BAL   R8,SVC11           DO THE SVC11
         B     EXIT               RETURN TO CALLER
*
*
KTLST    EQU   *
*
         BAL   RE,ENTER
         LIS   R0,2               STATUS FCN
         BAL   R8,SVC11           DO THE SVC11
```

```
         L      R1,DATA(SP)          LOAD RETURNED VALUE
         CHI    R0,3                 LOOK AT STATUS
         BNZ    STAT1                SKIP IF NOT OFF-LINE
         LCS    R0,1                 RETURN STATUS -1 AS KTLST
         LCS    R1,1                 RETURN -1 AS VALUE
STAT1    ST     R1,0(R7)             STORE DATA IN VALUE
         B      EXIT                 RETURN TO CALLER
*
*
KTLPND   EQU    *
*
         BAL    RE,ENTER
         LH     R0,TASKQ+2           FCN = NO OF ENTRIES QUEUED
         LR     R1,R0                RETURN AS VALUE, TOO
         B      STAT1                RETURN
*
*
*
         TITLE MAIN KTL ROUTINES, INTERRUPT-RELATED
*
*
         ALIGN 4
TASKQ    DLIST 10                    DEFINE A TASK QUEUE
TQEN     DC     Y'08008000'          ENABLE TQ ENTRY AND TRAP
         DAC    0                    LOC. COUNTER, ==> RETURN
*
*
KTLON    EQU    *                TURN ON CONNECTION TO A DEVICE
*
         BAL    RE,ENTER
         L      R1,UDL.TSKQ          LOAD ADDR OF TASK QUEUE
         BNZ    HAVEQ                SKIP IF HAVE A QUEUE
         LI     R2,TASKQ             ADDR OF QUEUE DEFINED HERE
         ST     R2,UDL.TSKQ          STORE IT AT QUEUE POINTER
         LI     R0,Y'A0000'          SIZE OF QUEUE
         ST     R0,0(R2)             STORE IT IN QUEUE
         LIS    R0,0                 NUMBER NOW ON QUEUE
         ST     R0,4(R1)             STORE IT IN QUEUE
         LI     R2,Y'8000'           NEW TSW: ENABLE TQ ENTRY
         ST     R2,UDL.TSKN          STORE AS TSW DURING INT.
*
HAVEQ    EQU    *                    NOW HAVE VALID TASK QUEUE
         LI     R2,INTVEC            ADDRESS OF INT. HANDLER
         ST     R2,UDL.TSKN+4        STORE PTR TO INT. ROUTINE
         ST     R5,USRINT            SAVE USER ROUTINE ADDR
         LI     R3,Y'C0008000'       CONNECT SELF SVC6 FUNCTION
         BAL    R8,SVC6              CONNECT TASK TO DEVICE
*
         SVC    9,TQEN               ENABLE TASK INTERRUPTS
         LIS    R0,3                 ENABLE-INT. SVC11 FUNCTION
         B      DO11                 DO SVC11 TO ENABLE INT.
*
```

```
*
KTLOFF   EQU   *                TURN OFF CONNECTION TO DEVICE
*
         BAL   RE,ENTER
         LI    R3,Y'C0000800'    DISCONNECT SELF SVC6 FCN
         BAL   R8,SVC6           DISCONNECT TASK FROM DEV.
*
         LIS   R0,4              DISABLE-INT. SVC11 FCN
DO11     BAL   R8,SVC11          DO SVC11 TO DISABLE INT.
         LR    R0,R3             RETURN SVC 6 STATUS
         B     EXIT              RETURN TO CALLER
*
*
KTLWAT   EQU   *                 WAIT FOR TASK TRAP
*
         SVC   9,TSWAIT          LOAD A WAITING TASK STATUS
*
         ALIGN 4
TSWAIT   DC    Y'88008000'       ENABLE DEVICE-GENERATED
*                    QUEUE ENTRIES, SERVICE TRAPS, & WAIT
*
*
KTLSIM   EQU   *
         BAL   RE,ENTER
         LIS   R0,5              SIMULATE-INTERRUPT FCN
         BAL   R8,SVC11          DO THE SVC11
         B     EXIT              RETURN TO CALLER
*
*
*
         TITLE SUBROUTINES TO DO SVC 6 AND 11 CALLS
*
DUMNO    EQU   *                 TABLE OF DUMMY DC3 NO'S
         DB    9,0,1,9           AS FUNCTION OF PUN
         DB    2,9,3,9
         DB    9,9,4,9
         DB    4,9
*
*
         ALIGN 2
SVC6     EQU   *                 LOCAL SUBROUTINE
*
         LB    R0,DUMNO(R4)      LOAD DUMMY NO.
         AI    R0,C'DUM0'        FORM DUMMY NAME
         ST    R0,DEVMNEM(SP)    STORE IT IN PARAM BLOCK
         ST    R3,SIXFCN(SP)     STORE FUNCTION
         SVC   6,SIXBLK(SP)      DO SVC6 CONNECT/DISCONNECT
         LH    R3,SIXSTAT(SP)    LOAD SVC6 STATUS
         BR    R8                RETURN
*
*
*
```

```
SVC11    EQU   *                    LOCAL SUBROUTINE
*
         STB   R0,FCN(SP)           STORE REQUESTED FUNCTION
         STB   R4,DVN(SP)           STORE DEVICE NO.
         ST    R5,DATA(SP)          STORE DATA
         SVC   11,FCN(SP)           DO THE SVC 11
         LB    R0,STATUS(SP)        LOAD THE STATUS RETURNED
         BR    R8                   RETURN
*
*
         TITLE ROUTINES CALLED BY INTERRUPT HANDLERS
*
         ALIGN 4
RSAVE    DS    16*4                 REGISTER STORAGE AREA,
FPSAVE   DS    16*4                  DURING INTERRUPT ROUTINE
*                                  (WHICH IS NON-INTERRUPTABLE)
USRINT   DS    4                    STORAGE FOR USER'S VECTOR
*
INTVEC   EQU   *                    OS VECTORS TO HERE ON INT.
*
         STM   R0,RSAVE             SAVE INTERRUPTEE'S REG
         STME  R0,FPSAVE
*     THESE REGISTERS WILL BE RESTORED BY KTLRET
         L     R0,USRINT            ADDRESS OF USER'S ROUTINE
         BR    R0                   GO TO USER, WHO CALLS:
*
*
KTLRD    EQU   *                    RETURN INPUT DATA:
*
         LI    RC,OWN               SWITCH TO OWN STACK
         BAL   RE,ENTER
         RTL   R5,TASKQ             POP PARAMETER FROM QUEUE
         LR    R4,R5
         EXHR  R4,R4
         NHI   R4,X'FF'             MASK TO LOW BYTE
         ST    R4,0(R6)             STORE UNIT NO.
         NHI   R5,X'FF'             MASK TO LOW BYTE
         ST    R5,0(R7)             STORE VALUE READ IN
         LIS   R0,0                 LOAD OK STATUS
         B     EXIT                 RETURN TO CALLER
*
*
KTLEN    EQU   *
*
         BAL   RE,ENTER
         LIS   R0,3                 ENABLE-INTERRUPTS FCN
         BAL   R8,SVC11             DO THE SVC11
         B     EXIT                 RETURN TO CALLER
*
*
KTLRET   EQU   *          CALLED  L A S T  BY INT. ROUTINE!
*
```

```
        LM      R0,RSAVE            RELOAD INTERRUPTEE'S REG
        LME     R0,FPSAVE
        SVC     9,UDL.TSK0           AND TASK STATUS WORD
*
        ALIGN   4
        DS      580                 LOCAL STACK
OWN     DS      4                   TOP OF STACK
        END
```

```
C       WAITMS   :   SUBROUTINE TO DELAY THE CALLER
C
C       WAITMS HAS ONE CALLING PARAMETER, THE LENGTH OF TIME,
C        IN MILLISECONDS, THAT THE CALLER'S TASK IS TO BE
C        DELAYED.
C       WAITMS USES SVC 2 TO GENERATE A TRUE TIMED DELAY.
C
      SUBROUTINE WAITMS(MS)
      INTEGER MS
C
      I=MS
$ASSM
      ST    11,PARAM
      SVC   2,BLOCK
      BS    DONE
      ALIGN 4
BLOCK DB    0,11
PARAM DCF   0
DONE  EQU   *
$FORT
      END
```

```
C
C     ******************** A6DAT ********************
C     THIS PROGRAM IS TO HANDLE DATA FOR THE
C     PRIMARY RECEIVER.
C
C
      DIMENSION CNTIME(6)
      DATA CNTIME /'?U2@G2','?U2@G1','?U2@G0','?U2@G'?',
      '?U2@G>','?U2@G='/
C     CNTIMES ARE /100S,10S,1S,100MS,10MS,1MS/
C
C
C     INITIALIZE BUS AND COUNTER
C
C
      CALL HPCMD(?U2@E8E2)
      CALL WAIT
C
C
C     ENTER THE NM3R FOR THE DESIRED CNTIME
C
C
      WRITE(5,5)
    5 FORMAT ('ENTER CNTIME 1,2,3,4,5, OR 6)
      READ (5,10)L
   10 FORMAT (I1)
C
C
C      SET COUNTER TO DESIRED CNTIME
C
C
      CALL HPCMD (CNTIME(L))
      CALL WAIT
C
C
C      READ THE COUNTER
C
C
   20 CALL HPCMD(?UR)
      CALL WAIT
      CALL HPDATA (CNT)
      CALL WAIT
C
C
C       USE COUNTER VALUE TO CALCULATE SIGNAL FREQ
C       AND DISPLAY RESULT ON STAT.
C
C
C       THIS CALC. WILL CHANGE FOR EACH CNTIME DUE
C       TO THE RETURNED VALUF NUMBER OF SIG. DIGITS.
C        CURRENT CALC. IS A DUMMY
C
```

```
      RF = CNT*200
      IP1=Y'0F000000'
      IP2=Y'45000000'
      IP3=Y'40000000'
      WRITE (3,500)IP1,IP2,IP3,RF
  500 FORMAT (3A1,'SIGNAL = ',F11.7)
C
C
C        DELAY THEN READ COUNTER AND UPDATE DISPLAY
C
C
      DO 505 I=1,500000
  505      CONTINUE
      GO TO 20
      END
```

```
C
C
C       THE PURPOSE OF THIS SUBROUTINE IS TO INITIALIZE
C       THE MAIN RECEIVER COUNTER.
C
C
C       THE SUBROUTINE IS UNDER FILE NAME CNTSET.FTN.
C
C
        SUBROUTINE CNTSET
        INTEGER CODE(4)
        CODE(1)='?U2,'
        CODE(2)='E8E1'
        CODE(3)='E2G0'
        CODE(4)=''
        CALL HPCMD(CODE)
        CALL WAIT
        RETURN
        END
```

```
C
C
C       THE PURPOSE OF THIS SUBROUTINE IS TO READ THE
C       MAIN RECEIVER COUNTER.
C
C
C       IT IS UNDER FILE NAME CNTDTA.FTN
C
C
        SUBROUTINE CNTDTA(CNT)
        INTEGER CODE(4)
        CODE(1)='?R5'
        CODE(2)=''
        CODE(3)=''
        CODE(4)=''
        CALL HPCMD(CODE)
        CALL WAIT
        CALL HPDATA(CNT)
        CALL WAIT
        RETURN
        END
```

```
C
C
C       THIS SUBROUTINE READS THE TIME
C
C
C     IT IS UNDER FILE NAME TIME.FTN
C
C
      SUBROUTINE TIME(T)
      INTEGER CODE(4)
      CODE(1)='?J5'
      CODE(2)=''
      CODE(3)=''
      CODE(4)=''
      CALL HPCMD(CODE)
      CALL WAIT
      CALL HPDATA(T)
      CALL WAIT
      RETURN
      END
```

```
C
C
C       THE PURPOSE OF THIS SUBROUTINE IS TO WRITE COMMANDS
C       TO THE MAIN RECEIVER COUNTER TO CAUSE IT TO GO TO
C       THE DESIRED COUNT PERIOD.
C
C
C       THE FILE NAME FOR THIS SUBROUTINE IS CNTIME.FTN.
C
C
        SUBROUTINE CNTIME(K)
        INTEGER CODE(4)
        CODE(1)='?U2,'
        CODE(3)=''
        CODE(4)=''
        GO TO (10,20,30,40,50,60),K
        GO TO 80
10      CODE(2)='G2'
        GO TO 70
20      CODE(2)='G1'
        GO TO 70
30      CODE(2)='G0'
        GO TO 70
40      CODE(2)='G?'
        GO TO 70
50      CODE(2)='G>'
        GO TO 70
60      CODE(2)='G='
        GO TO 70
70      CALL HPCMD(CODE)
        CALL WAIT
80      RETURN
        END
```

```
C
C       SUBROUTINE HPCMD TRANSFERS COMMANDS TO THE HP BUS THROUGH
C       THE HP 9830.
C
        SUBROUTINE HPCMD(CODE)
        INTEGER CODE(4)
        ITYPE='1'
100     WRITE(5,110) ITYPE,CODE
110     FORMAT(A1,4A4)
        RETURN
        END
```

```
C
C       SUBROUTINE HPDATA READS DATA FROM THE BUS
C       THROUGH THE HP 9830
C
        SUBROUTINE HPDATA(DATA)
        INTEGER DATA(18)
        ITYPE='3'
300     WRITE(5,310) ITYPE
310     FORMAT(A1)
320     READ(5,330) DATA
330     FORMAT(18A4)
        RETURN
        END
```

```
C
C
C     THIS SUBROUTINE CAUSES THE SYSTEM TO WAIT UNTIL THE
C     HP 9830 HAS COMPLETED ITS TASK.
C
C
      SUBROUTINE WAIT
40    READ(5,50) N
50    FORMAT(A1)
      IF (N.EQ.'5') GO TO 70
      GO TO 40
70    DO 100 I=1,5000
100   CONTINUE
      RETURN
      END
```

```
10 REM    THE PURPOSE OF THIS PROGRAM IS TO ALLOW THE HP 9830
20 REM    TO ACT AS A DATA LINK BETWEEN THE 7/32 AND THE IEEE
30 REM                                              488 BUS
40 REM     DIMENSION THE STRING VARIABLES TO BE USED
50 DIM A$[72],B$[72],C$[72],D$[72],E$[72]
60 REM
70 REM    SET UP THE SYSTEM FOR THE DATACOMM LINK
80 REM
90 SYSTEM 1,9600,8,NONE,ASY2,FD
100 EOT 15
110 TON 1
120 REM
130 REM    INITIALIZE THE BUS
140 REM
150 CMD "?U.8*"
160 FORMAT B
170 OUTPUT (13,160)768;
180 CMD "?U"
190 FORMAT 3B
200 OUTPUT (13,190)256,25,512;
210 REM
220 REM    READ THE INTERDATA MT 7/32
230 REM
240 TREAD( 1,ASC)A$
250 REM
260 REM     DETERMINE WHAT THE 7/32 WANTS TO DO
270 REM
280 B$=A$[1,1]
290 IF B$="1" THEN 360
300 IF B$="2" THEN 540
310 IF B$="3" THEN 620
320 GOTO 240
330 REM
340 REM    ROUTINE FOR THE CMD
350 REM
360 A=POS(A$,",")
370 IF A=0 THEN 460
380 B=A-1
390 C$=A$[2,B]
400 C=A+1
410 S=LEN(A$)-1
420 D$=A$[O,S]
430 CMD C$,D$
440 TWRITE( 1,ASC)"5",15,
450 GOTO 240
460 S=LEN(A$)-1
470 C$=A$[2,S]
480 CMD C$
```

```
490 TWRITE( 1,ASC)"5",15,
500 GOTO 240
510 REM
520 REM    ROUTINE TO CHECK THE BUS STATUS
530 REM
540 IF (STAT13=0) THEN 570
550 TWRITE( 1,ASC)"0",15,
560 GOTO 240
570 TWRITE( 1,ASC)"1",15,
580 GOTO 240
590 REM
600 REM   ROUTINE TO ENTER DATA FROM THE BUS
610 REM
620 ENTER (13,*)E$
630 WAIT 50
640 TWRITE( 1,ASC)E$
645 WAIT 50
650 WAIT 50
660 TWRITE( 1,ASC)"5"
670 GOTO 240
6-0 END
```

APPENDIX C - ACRONYMS AND MNEMONICS

This appendix contains a list of the acronyms and mnemonics used throughout this report and the appended programs.

C2	Primary Receiver Control Panel
A6	Primary Receiver
A7	Frequency Counter
A8	Primary Receiver Local Oscillator
LFBW	Loop Filter Bandwidth
IFBW	Intermediate Frequency Bandwidth
VCO	Voltage Controlled Oscillator
S/S	Steady-State
N/SQ	Normal or Squaring
MGC	Manual Gain Control
PLL	Phase Locked Loop
C20P	Control Panel Operating Program
LO	Local Oscillator
PNLON	Panel On
PNLOFF	Panel Off
DATENT	Data Entry
DPT	Decimal Point
IDOT	Program Data for Receiver Control
NVAL	Program Data for Numeral Button Values
IFREQ	Program Data for Satellite Frequencies
JFREQ	Variable to Specify a Satellite
NTYPE	Variable to Specify a Data Entry Button
NBUT	Variable to Specify a Button Number
NMBR	Variable to Specify a Number Entry
CHAN	Channel
CFREQ	Center Frequency
ISTAT	Variable to Describe Receiver Status(IN/OUT of LOCK)

ISTEP	Variable to Specify LO Step Size in Acquisition
IP1,IP2,IP3	Variables to Position Display on CRT
CNT	Variable for Frequency Counter Reading
T	Variable for Time
STAT	Display CRT at Operator's Console
CNTIME	Gating Time for Frequency Counter
CODE()	ASCII Variable to Control Frequency Counter
IDLAY	Variable to Specify LO Step Delays During Acquisition

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